The FOUNDRY

Volume 50
Number 12

Published
Semimonthly

CLEVELAND, OHIO, JUNE 15, 1922

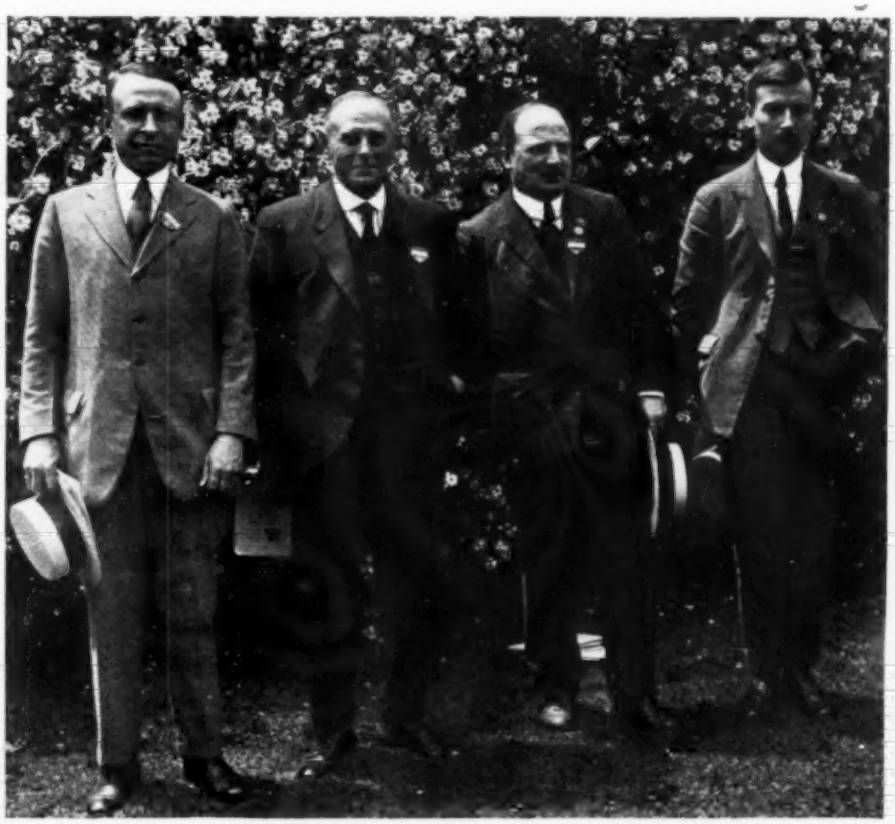
Benefits from Industry's Rebound

Effect of Business Recovery upon Castings Manufacture Evidenced in Exhibition and Enthusiastic Sessions of the American Foundrymen's Association in Rochester

THAT the decision to dispense with the regular annual meeting of the American Foundrymen's association last year was wise was fully demonstrated by the remarkably successful meeting held in Rochester June 5 to 9. Had the meeting been held during the period of industrial depression just passed, the effect could not but have been felt. However, the lessons of the lean years in castings manufacture and the present urgent needs of better practice served to bring many new ideas to the technical discussion. No previous meeting of the associations has recalled the Rochester gathering in the point of attendance at the session or in the enthusiasm and interest evidenced in the discussions. Adversity had sharpened the collective industry. The international session, held Tuesday morning was particularly lively. F. J. Cook's friendly comparison of British and American iron in which odds were granted to the former product, evoked a rapid fire interchange of ideas. The tendency was to approach more closely to a common ground where the merits and faults of the respective iron castings might be compared.

The steel sessions held Tuesday and Wednesday mornings awakened keen interest. New specifications, the points of which appear in another portion of this issue, impending improvement in annealing practice and the advance in melting practice all testified to the fact that the steel castings industry has not lost ground during the period of business depression.

Greater attention was given to nonferrous subjects than ever before. Four sessions held during Tuesday and Wednesday, two by the Institute of metals Division of the American institute of Mining and Metallurgical Engineers one by the American Foundrymen's association and one joint meeting afforded ample opportunity for presenting the problems of brass and aluminum foundrymen. Industrial relations were studied at a well attended meeting held Wednesday afternoon and formed the theme of the address delivered by Gov. H. J. Allen at the annual banquet, when he stated that the



DISTINGUISHED GUESTS OF THE ASSOCIATION

Left to right: C. R. Messinger, vice president, American Foundrymen's association; F. J. Cook, Birmingham, Eng'and; M. Remy, Belgium; R. Gailly, France.

C. R. MESSINGER

C. R. Messinger, president-elect of the American Foundrymen's association, has been identified with the iron and steel industry since he was graduated from the Sheffield Scientific school, Yale university, New Haven, Conn., in 1906. Mr. Messinger immediately upon leaving school became representative for the Harbison-Walker Co. in Pittsburgh and Chicago. In 1909 he joined the organization of the Sivyer Steel Castings Co., Milwaukee and was made secretary and general manager. Later he was advanced to the position of vice president and general manager and in 1917 was made vice president and general manager of the Chain Belt Co., Milwaukee, with which he has been identified since 1912. Mr. Messinger also is president of the Interstate Drop Forge Co., Milwaukee. He was elected a director of the American Foundrymen's association in Milwaukee in 1918. At the Columbus convention in 1920 he was made vice president and his election as president for the succeeding year just has been announced in Rochester. Mr. Messinger's other affiliations of a technical and business nature include membership in the American Society of Mechanical Engineers; chairman, Electric Steel Founders' Research Group; chairman, executive committee, Malleable Chain Manufacturers' institute; director, Milwaukee Metal Trades and Founders' association; and director in the Association of Commerce, Milwaukee.

court of industrial relations established at his suggestion in Kansas has been successful. The speaker cited 235 cases adjudicated by the court, of which only two decisions had been contested. C. R. Messinger, president elect presided in the absence of President W. R. Bean, whose illness prevented his attendance at the convention. Rowland B. Woodward, secretary of the Rochester chamber of commerce acted as toastmaster and introduced the speakers. F. J. Cook, delegate from the Institution of British Foundrymen, speaking at the banquet presented the greetings of the great technical, engineering and foundry associations of Great Britain. He read a cablegram of felicitations from Oliver Stubbs, president of the Institution, who recently returned to England following a tour of this country. Mr. Cook dwelt upon the inability of agitators abroad to shake the friendly feeling which exists for America.

Rochester sustained its reputation for hospitality in the entertainment features provided, in addition to the many evidences of cordiality apparent to the individual. Automobile rides and musical recitals were arranged for the ladies, while on Thursday afternoon a boat was chartered for the pleasure of the visitors. During the boat ride on Lake Ontario, entertainment was provided for over 1000 of the visitors, and a landing was made at Cobourg, Ont.

Opening the international session association Tuesday, June 6, A. O. Backert, past president of the American Foundrymen's Association, referred to the manner in which the industry would be benefited by the exchange papers now transmitted between America, Great Britain, France and Belgium. The first paper of the series was written by G. K. Elliott, Lunkenheimer Co., Cincinnati and presented at a meeting of the Institution of British Foundrymen last year. Enrique Touceda recently has sailed for England where he presents a paper on malleable foundry practice at the annual meeting of the Institution of British Foundrymen assembled in convention in Birmingham. In the name of the American Foundrymen's association, Mr. Backert extended greetings to the representatives of foreign foundrymen's associations present including F. J. Cook, Rudge-Littley, Ltd., Birmingham, former president of the Institution of British Foundrymen; M. Remy, Belgium and R. Gailly, a prominent French foundryman who read a message from E. Ronceray, president, Societe Anonyme des Etablissements Ph. Bonvillian & E. Ronceray, Paris. He also expressed in English the sentiments of Mr. Remy touching on the high regard in which America and American institutions are held in his native land. Mr. Cook read a cable received that morning from Oliver Stubbs, president, Institution of British Foundrymen extending greetings felicitations and best wishes for the success of the convention. C. R. Messinger, Sivyer Steel Casting Co., Milwaukee, president elect American Foundrymen's association, Major R. A. Bull, Electric Steel Founders Research Group, Chicago, former president of the association and G. A. Clamer, Ajax Metal Co, Philadelphia and vice president elect American Foundrymen's association, were appointed a committee to prepare and forward suitable greetings to the foreign associations.

New A. F. A. Officers

PRESIDENT

C. R. Messinger, Sivyer Steel Castings Co., Milwaukee

VICE PRESIDENT

G. H. Clamer, Ajax Metal Co., Philadelphia

DIRECTORS

C. B. Connelley, Harrisburg, Pa.
Fred Erb, Packard Motor Car Co., Detroit
C. E. Hoyt, American Foundrymen's association, Chicago
L. W. Olson, Ohio Brass Co., Mansfield, O.
A. B. Root, Jr., Hunt-Spiller Mfg. Corp., Boston

The first paper submitted, a memoir prepared by the Association Technique de Fonderie de France entitled, Destruction and Reconstruction of French Foundries was read by Mr. Gailly and illustrated by numerous lantern slides showing first the ruins and wreckage and afterward some of the reconstructed foundries as they appear today.

A paper on European versus American molding machine practice, prepared by E. Ronceray, president Society Anonyme des Etablissements Ph. Bonvillian & E. Ronceray, Paris, was read in abstract.

Making Typewriter Frames in a Bel-

G. H. CLAMER

Guilliam H. Clamer was declared elected vice president of the American Foundrymen's association at its Rochester meeting. Mr. Clamer ranks among the foremost metallurgists in the nonferrous casting industry. He was born in Philadelphia 45 years ago, where he now is located as first vice president, secretary and general manager of the Ajax Metal Co. and president of the Ajax Electrothermic Corp. For two years after he was graduated from the schools of Philadelphia, he worked in the private chemical laboratory of Dr. F. A. Genth. He then entered the University of Pennsylvania as a special student in chemistry and finally worked into the regular course, from which he was graduated in 1897. He immediately became affiliated with the Ajax Metal Co. in the capacity of chemist. Mr. Clamer was one of the first chemists regularly employed in the brass and bronze business. In 1898 he began the study of metallography, being one of the pioneers in the metallographic study of nonferrous metals. It was Mr. Clamer who developed a process for eliminating zinc, aluminum and iron and other metals electro-positive to copper, tin and lead from alloys containing all of these metals. For this investigation he was presented with the Eliott-Cresson gold medal, the highest award of the Franklin institute. He has been likewise associated with Dr. Carl Hering, James Wyatt and Dr. Edwin F. Northrup of Princeton university in the development of electric furnaces. He is a past president of the American Society for Testing Materials and of the American Institute of Metals, now the institute of metals division of the American Institute of Mining and Metallurgical Engineers and committee on science and arts of the Franklin institute.

gian Foundry, a paper by Joseph Leonard, president, Association Technique de Fonderie de Liege, Herstal, Belgium and constituting the annual exchange paper between the associations, was read by title. This paper appears on page 497.

On suggestion of the chair, the three following papers, related to a certain extent in general features, were read before discussion was opened on any one: Annealing of Gray Iron, by J. F. Harper and R. S. McPherron, Allis-Chalmers annealing to relieve machine or casting strains. Annealing at 1050 degrees does not seem to decrease materially the hardness or strength. Temperatures of from 1450 to 1550 degrees Fahr. are satisfactory for annealing to increase machineability only, but it has been found that the drop in hardness is accompanied by loss in strength. From the tests it appears that until the temperature exceeds the critical point, the rate of cooling has no effect on the physical properties of the cast iron under investigation.

Amplifying the second paper extemporaneously, Dr. Richard Moldenke dealt with the problem incident to keeping various charges and mixtures separate in a continuous cupola run. He related experience connected with an extensive series of tests with Cuban ores containing nickel and chromium. On four test charges in each heat, the first contained no ore, the second 10 per cent, the third 15 per cent and the fourth 20 per cent. Despite the fact that the charges were separated even more carefully than usual the iron from the first charge showed an average of 0.10 per cent nickel and 0.23 per cent chromium. Inasmuch as none of the iron in the first charge contained an appreciable amount of these elements it is apparent that the iron from the cuban ore in the upper charges melted before the metal below had been used. This bears out a contention frequently advanced that iron melts higher than generally supposed in the cupola. He condemned the practice of placing pig iron around the rim of the charge with the scrap in the center.

The annual exchange paper of the Institution of British Foundrymen, American versus British Cast Iron, which was presented by F. J. Cook, appears on page 491 of this issue.

Mr. Cook stated that he has tested bars over a period of 500 consecutive working days which showed an average of 36,288 pounds. No test was as low as 30,240 pounds and the highest was 43,008 pounds. He claimed that American foundrymen pay too little attention to the total carbon content. Silicon content is used as a base and sulphur is taken much more seriously in the United States than in Great Britain. The dis-

Three New Directors Named for A. F. A.

CLIFFORD B. CONNELLEY, commissioner of labor and industry of Pennsylvania, has been elected a director of the American Foundrymen's association. Mr. Connelley was born at Monongahela City, Pa., March 26, 1863. He learned the trade of patternmaker and was identified with this trade for some time. He was a member of the Patternmakers' league and organized the industrial work for the schools of Allegheny, Pa. Later he became attached to the Pittsburgh manual training schools, Western University of Pennsylvania, and then with the Carnegie Institute of Technology, of which he became dean of the school of applied industries. He is an active factor in the A. F. A.

LOUIS W. OLSON, recently made a director of the American Foundrymen's association, was born in Wisconsin in 1878. He was graduated from the University of Wisconsin in electrical engineering in 1899. After engaging in construction work for two years, he became connected with the Ohio Brass Co., Mansfield, O., as draftsman. Later he was made factory superintendent, and in 1920 was appointed factory manager, the position which he holds at present. Mr. Olson was president of the American Institute of Metals in 1912 and 1913.

A. B. ROOT JR., mechanical engineer, Hunt-Spiller Mfg. Corp., Boston, has been chosen a director of the American Foundrymen's association. Mr. Root was graduated from Tufts college in 1909. He was a maintenance of way engineer for the Boston & Albany railroad and for four years following was resident engineer for the Stone-Webster Engineering Corp. in charge of hydro-electric and steel power plant work. In 1913 Mr. Root became associated with the firm with which he is now connected. He was president of the New England Foundrymen's association in 1918-1919 and was a director in the American Foundrymen's association in 1919 and 1920.

Co., Milwaukee; Cupola Melting Tests with Mixtures Changing During Run, by Richard Moldenke, Watchung, N. J.; and American vs. British Cast Iron, by F. J. Cook, Rudge-Littley, Ltd., Birmingham, England.

J. F. Harper read the first paper, illustrated by charts and micrographs covering an investigation conducted to determine the correct time and temperature for annealing gray iron castings and also to determine the effect of annealing and quenching on the physical properties. The results of the tests indicate that a temperature of 1150 degrees Fahr. for one hour should not be exceeded when

tribution of phosphorus rather than the amount is the important consideration. The temperature at which iron is made in the blast furnace has a direct effect upon the formation of a network structure in gray iron. He advanced the opinion that the difference in strength between the iron made in the two countries may be due to the prevailing blast furnace practice, the slow running furnaces in Great Britain producing better iron than that made in the large American furnaces pushed to capacity.

Written and oral discussion on Mr. Cook's paper was submitted by R. S. McPherron, Allis-Chalmers Co., Milwaukee; E. J. Lowry, Hickman-Williams Co.; Dr. Richard Moldenke, Watchung, N. J.; C. K. Elliott, Lunkenheimer Co., Cincinnati; Harrington, Hunt-Spiller Corp., Boston; H. B. Swan, Cadillac Motor Co., Detroit, Mich., S. B. Phelps and M. Remy, Belgium.

Common Basis Lacking

Mr. McPherron's paper in the absence of the author was read by J. F. Harper who is associated with Mr. McPherron in conducting research work at the Allis-Chalmers plant. He claimed that owing to a possible misconception of details it was difficult for foundrymen in one country to secure a proper conception of conditions in another. For instance, although a tensile strength of 30,000 pounds was usual on American iron, no difficulty was experienced in making iron having a tensile strength of 42,000 pounds. A high tensile strength was not considered an essential factor in the iron used for large cylinder liners. Provided it was sufficiently hard to render good wearing qualities, tensile strength was of comparatively secondary importance. Basing his statement on the records of the Allis-Chalmers Co., and commenting on Mr. Cook's remarks that an abnormal number of American made fly wheels break in service every year, he claimed that over a period of 45 years his company has built more than 7000 engines aggregating over 6,000,000 horsepower on which fly wheels have run up to a peripheral speed of 6000 feet per minute and in all that time only two or three fly wheel failures have been reported and they were directly traceable to overspeeding due to accidents to the governing devices. It is common belief that warm blast charcoal iron is not as strong or as good as cold blast and it is quite possible that warm blast iron might be better than hot blast iron. A large percentage of American foundries purposely reduce the total carbon by adding steel to the charge in the cupola. Apparently this is not the English practice. The influence of sulphur has been overestimated. Any number of good castings have been made containing up to 0.18 per cent sulphur.

Referring to the statement, "Recently some improvement has been noticed in American machine tools attributed to wider bearing surfaces and the application of chills on the wearing surfaces, combined with the use of semisteel," S. B. Phelps, stated that for several years before the war he had melted from 50 to 60 tons of iron a day in a machine tool foundry. Several grades of iron were made as well as semisteel for parts subject to wear, also chills were used liberally for the same purpose. The practice was not an innovation but was generally observed in foundries devoted to that class of castings. It is possible that during the war period novices in the foundry line may have turned out work of an indifferent character, but he felt that standard American tools were of a distinctly high character and quality.

Specialize in Foundry Iron

George K. Elliott, Lunkenheimer Co., Cincinnati, in his written discussion suggested that possibly Mr. Cook was comparing English iron of the first class with American iron of the second class. He is a persistent advocate of specialization in foundry irons and therefore hailed this part of the paper with especial satisfaction because it adds emphasis to a point the importance of which is not properly realized in engineering circles. Referring to the statement that Ameri-

can cast iron fails under exposure to superheated steam he has yet to see the first valve or fitting made of suitable iron that has failed in this service. They are made by American manufacturers specializing in this line. It would be interesting to know if the tensile strength figures secured by Mr. Cook represent special cases or ordinary jobbing foundry practice. Under special conditions American foundry irons even without steel additions have shown as high a tensile strength. The attempt to reconcile the strength of the 1¼-inch round American arbitration bar with that of the British 1-inch square bar by use of the constant 0.74 is not to be commended because no account seems to have been taken of the quite different manner in which square and round bars form crystals while cooling.

Tests Will Show

In the case of carbon in cast iron it will be found that more iron foundries in this country pay attention to it than is supposed. It is to be hoped that a more general adoption of dynamic or shock tests is near at hand for these tests will increase our knowledge of the differences between irons now apparently the same as far as the usual tests indicate. Difficulty of controlling the carbon through the addition of steel was dealt with by E. J. Lowry, Hickman, Williams Co.

Dr. Moldenke agreed in part with some of the points raised in the paper, but was not in accord with the general claim that British cast iron was such a superior product.

Walter Wood, R. D. Wood & Co., Philadelphia regretted that a movement started about 16 years ago to adopt an international system of tests had been halted by the war and never resumed, and suggested that the time was at hand for reopening the subject. Following his remarks, Dr. Moldenke submitted the resolution presented on page 481 advocating a movement to have the work resumed.

When the 1052 foundrymen and guests unloaded at Cobourg, photographer C. E. Bunnell, Rochester, secured the group appearing on this and the preceding page. Are you there?

Heating metal patterns electrically to prevent the sand from sticking to them, was the subject of a paper presented by C. A. Cremer, Westinghouse Electric & Mfg. Co. E. Pittsburgh at the general and gray iron session held in the basement of the assembly hall Wednesday morning. The committee appointed to draft a suitable form of cost system submitted a report through its chairman, J. Roy Tanner, Pittsburgh Valve & Foundry Co., Pittsburgh. A series of suggested forms was presented for which a sufficient flexibility was claimed so that the organizations smaller than the average may condense and those larger than the average may expand them to cover their peculiar conditions.

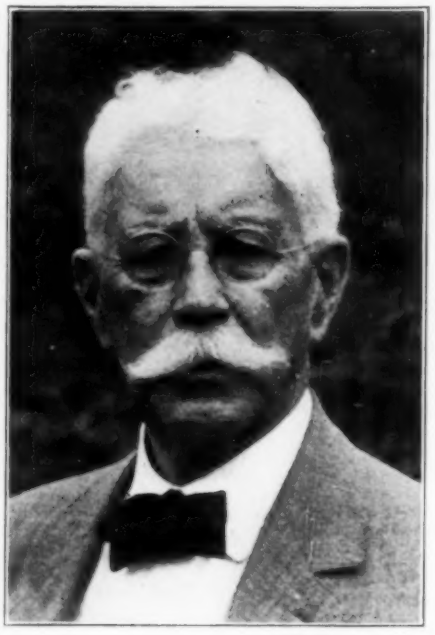
Apprentice Training

C. B. Connelley, Harrisburg, Pa., commissioner of labor, for the state of Pennyslvania submitted the report of the committtee on apprentice training of which he was chairman. The great need of the present day is some incentive that will induce boys and young men to learn a trade of some description. The general apathy of those in direct charge of manufacturing plants in which skilled labor is employed is to be deplored and will prove to have been a costly error in the years to come. While it is true that manufacturing processes are becoming more and more specialized and machinery of a more or less automatic character is being introduced to a greater extent every year, still the fact must not be overlooked that skilled labor is required to produce these machines. Common labor may be taught to operate machinery, but a fundamental knowledge of the processes involved in the production of castings is required on the part of those directing the en-

JAMES F. LANIGAN

ONLY a few of the charter members of the American Foundrymen's association attended the Rochester convention. Among those who are known generally as pioneers and who have attended practically every convention since the first one in Philadelphia were James F. Lanigan, proprietor Davis Foundry Co., Lawrence, Mass., and Robert C. Tolmie, general manager, Lobdell Car Wheel Co., Wilmington, Del. Mr. Lanigan will be remembered by old timers through his able speeches which marked the earlier conventions of the association. Mr. Langian has been in the foundry business for 60 years and for 47 years of this period he has been a foundry proprietor.

Mr. Tolmie, another veteran in the industry entered the foundry in 1845 when he was 10 years of age. He became a journeyman molder when he was 16 and has been connected with the Lobdell Car Wheel Co., since Nov. 18, 1864, working in various positions.



ROBERT C. TOLMIE

terprise and knowledge of that character cannot be absorbed without effort. A proper apprenticeship in which the youth is taught successively the various steps required is the only satisfactory method of producing master craftsmen. America with its cosmopolitan population presents a radically different problem in apprenticeship, or in any form of labor training, from that of any other country and the committee confesses that up to the present no satisfactory solution has appeared. Tentative suggestions have been advanced at various times, but the employers have evinced no interest. The ensuing discussion developed the point that while the foundry offered an attractive future to those who might rise to positions of importance, the outlook for the rank and file was not of such a character financially, or otherwise, as to appeal to boys of intelligence.

A memorial on corrosion of cast iron by H. Y. Carson, American Cast Iron Pipe Co., Birmingham, Ala., dealt with the many contributory causes of corrosion its effect on the grain structure as observed under the microscope, comparison of corrosion as observed in steel and concluded with the hope that the subject be given consideration by the A. F. A. in an effort to devise preventive measures. Dr. Richard Moldenke, Watchung, N. J., moved a resolution to the effect that the executive board of the American Foundrymen's association, take the question under advisement and in addition avail themselves of the work already done in this direction by the National Research council and by the U. S. Bureau of Standards.

At the close of what was described by C. E. Hoyt, secretary of the American Foundrymen's association, as one of the most successful and enthusiastic conventions in its history, officers for the ensuing year were elected according to the method recently adopted whereby the membership ballots by mail on candidates selected by the nominating committee. In this instance the ballot was unanimous in favor of the nominees and on motion of V. E. Minich the officers named on page 476 were declared duly elected. According to precedent established some years ago W. R. Bean, retiring president, was elected to honorary membership.

A committee of three, R. A. Bull, G. H. Clamer and W. B. Greenlee, was appointed to draw up suitable resolutions to be forwarded to the various foreign technical foundry associations which sent greetings, personal representatives and exchange papers. A telegram was read from W. R. Bean, retiring president, whose severe illness prevented him from attending the convention, expressing his deep appreciation of the many messages of condolence received from the association officially and from various individual members.

Discussions Attack Nonferrous Problems

FOLLOWING a custom established sixteen years ago by the American Brassfounders association, now the Institute of Metals division of the American Institute of Mining and Metallurgical Engineers, nonferrous sessions of the Institute were held in conjunction with the American Foundrymen's association at Rochester, June 5 to 9 both organizations co-operating to present a program replete with interest. Whether from a purely scientific viewpoint, or in the practical operations incident to producing commercial castings the program offered much to everyone present.

The first separate session of the Institute was held at 9:30 a. m. June 6, and papers of a technical nature were presented. The session opened with a paper by C. Upthegrove and W. G. Herbert on the physical properties of cartridge brass which was illustrated by microphotographs of the structure of cartridge brass annealed at temperatures between 570 and 750 degrees Cent. The effect of impurities on electrolytic zinc was discussed by G. D. Scholl; the mechanism of metallic oxidation at high temperatures by N. B. Pilling and R. E. Bedworth; the extreme sensitiveness of the action of reducing atmospheres upon heated copper by T. S. Fuller

and some electrical properties of nickel and monel wires by F. M. Sebast, M. A. Hunter and A. Jones. At the nonferrous session of the American Foundrymen's association Tuesday afternoon, E. H. Dix discussed the technical control of the McCook field foundry, a small experimental foundry established at McCook field Dayton, Ohio, to guide the engineering division of the air service in working out brass foundry problems. This paper is presented at length in another page of this issue. A second paper of interest was on the subject of selecting fuels and furnaces for melting copper and its alloys by the late T. H. A. Eastick. A most interesting paper described an investigation of the causes leading to the segregation of alloys high in lead by R. E. Lee, and F. B. Trace, Allegheny College, Meadville, Pa. The subject of brass forgings was discussed by C. G. Hieby, and the session concluded with a lecture on the metallurgy and properties of nickel by Wm. M. Corse. In the discussion that ensued, Jesse L. Jones, Westinghouse Electric & Mfg. Co., Springfield, Mass., stated that a good idea of the quality of manganese bronze he had found could be obtained by means of a quickly made bending test in which a straight bar of the metal about 10 inches long was bent, the rigidity and elongation of the alloy could be judged by the resistance to the bend and the amount of distortion to which it could be subjected before breaking. The pouring temperature of 1900 degrees mentioned by Dix, was also criticised by S. D. Sleeth of the Westinghouse Air Brake Co., Wilmerding, Pa., who stated that he had found that castings of red metal poured at that temperature came full of dirt, but at 2100 deg. Fahr. were of good fracture and clean, while at 2400 degrees, the castings had split in two, the conclusion he had reached that 1900 degrees was a little too low and 2400 degrees a little too high in the case of pressure castings.

On the subject of selecting fuels and furnaces N. K. Patch remarked that he had tried fuel furnaces and electric furnaces of various types and had reached the conclusion that either of these types of furnaces would turn out satisfactory metal if well handled.

The joint session of the two associations dealt exclusively with aluminum and the alloys of that metal and papers were presented according to the program published. The paper on the use of secondary aluminum ingot will be presented in full in a subsequent issue of THE FOUNDRY. In melting secondary aluminum for ingots the discussion developed that it is important not to overheat and the pouring temperature must be kept as low as consistent with its filling the molds properly. Being more sluggish than virgin aluminum, it requires a higher temperature than the latter. After it has been skimmed and fluxed should there remain an excessive amount of oxide it will be a source of weakness in the alloy and productive of cracks in castings made therefrom. A flux of zinc chloride should be used to remove this oxide, and stress was laid on the importance of introducing this into the aluminum, instead of simply stirring it around on the surface as customary. This is done by use of an iron rod, one end of which for a few inches was bent to a right angle and then a spiral of wire is attached in such a manner it can be used to confine and hold the chloride and afford means for submerging it.

The subject of using chills also was discussed, their use being considered undesirable by the author of the paper. He advocated clean skimming with fluxing, soft cores, rosin being a good binder, combined with properly placed gates, adequate risers and careful attention to pouring temperature, as means for controlling objectionable shrinkage. Mention was made of the use of a mixture of half rosin and half powdered charcoal for getting clean, smooth castings. This is dusted on the finished molds, then blown off with air, as in the case of flour on molds for brass. The paper on melting furnaces proved of great interest and the request was made that R. J. Anderson state positively what he considered the best furnace for melting aluminum, but the latter found it difficult to comply. He suggested the iron pot as good for situations where it could produce sufficient metal, and for large production, a horizontal barrel-shaped rotating furnace using oil or gas fuel was coming into use. Some curiosity being expressed as to the analysis of those iron pots lasting for 300 heats, the answer was given that steel and ferromanganese were added to ordinary gray iron, the iron being in effect a semisteel. Iron melting pots lasting from 50 to 60 heats were about ⅞-inch thick and made of a low phosphorous iron—a stove foundry had in this case made the best pots.

At the concluding session of the institution the paper on the blue constituent in high strength manganese bronze proved of considerable interest to metallographists, the discussion centering on the probable composition of this constituent. The paper on gas absorption of nonferrous metals aroused great interest. The discussion brought out a more clean interpretation of the meaning of the term oxidixing atmosphere. This, it was explained, did not mean a strongly oxidizing flame, but a flame as near neutral as possible, inclining to the oxidizing nature, instead of the reducing. The authors of the paper suggest that in melting metals if a flame of the nature above mentioned is used that better results will be obtained, as greater freedom from porosity will result. In using a flame of an oxidizing nature, it is necessary

International Congress

FOLLOWING the presentation of a memorial by Walter Wood, R. D. Wood & Co., Philadelphia, Dr. Moldenke moved the adoption of the following resolution to which F. J. Cook, Institution of British Foundrymen, and M. Remy, Association Technique de Fonderie de Liege, Belgium, who also represented the French Foundry association spoke in approval. The resolution which will be submitted to the board of directors for action follows:

RESOLVED: That the American Foundrymen's association will welcome the resumption of deliberations looking toward international agreement upon methods of foundry procedure and specifications.

That the American Foundrymen's association deems an early agreement on an international test bar, and the purchase and use of pig iron by its analysis only, essential in the interest of intensified export trade. The American Foundrymen's association is prepared to cooperate with foundrymen's and engineering societies of other countries to this end.

WHAT'S WHAT IN BRASS
Jesse L. Jones, Westinghouse Electric & Mfg. Co. and Robert F. Wood, Monel Metal Products, talk it over.

to cover the metal with some flux that will insulate it from the furnace atmosphere to as great an extent as possible. As against the reducing atmosphere, it had been found that in an electric furnace of the resistor type, if burning wood was present, the castings invariably came porous, while with a slight excess of air in the furnace they came perfectly sound. This statement was not concurred in by all, and examples were cited as proving that it could not be accepted as proved that a reducing atmosphere was the cause of porosity in castings.

Keen Interest Shown in Steel Sessions

PROPOSED radical changes in specifications for steel castings were announced by R. A. Bull, Chicago, in the report of the committee on specifications for steel castings made at the steel session Tuesday afternoon, C. S. Koch presiding. Mr. Bull said that a specification for steel castings for railroad work, which does not include limits for ultimate strength would be proposed at the coming meeting of the American Society for Testing Materials and any member of the A. F. A. who objects to the requirements of the specifications could register his objection with A. H. Jameson, Bayonne Steel Castings Co., Bayonne, N. J., who is the representative of the A. F. A. on the committee on steel castings of the A. S. T. M. The requirements for tensile properties, as shown in the accompanying table indicate that while no limits for ultimate tensile strength are given, the requirements for elongation and reduction of area are made dependent upon the ultimate tensile strength of each individual specimen. These requirements are shown at the bottom of the table and are more severe than present requirements for steel castings. The new specification will cover only castings for railroad work and will not at present supersede the specifications for general steel castings.

As a result of this report the resolution was passed asking the executive committee to appoint a committee consisting of R. A. Bull, A. H. Jameson and W. R. Bean to co-operate with the A. S. T. M. in forming specifications for steel castings.

The paper by S. H. Cleland, National Engineering Co., Chicago, on the preparation of steel foundry sands provoked considerable discussion as to the comparative merits of the muller and the pan types of sand mixers. Mr. Cleland in his paper showed the function of the mixer to be to spread the bonding clay over the sand entirely and uniformly without crushing the grain. W. B. Natchtigall, Cleveland, told of making green-sand molds for steel castings, weighing as high as 600 pounds, from a facing made of sharp sand and a vegetable binder without the addition of clay. H. F. Harrington, Hunt-Spiller Co., Boston, called attention to the lack of competent surpervision of sand mixing in the average foundry and emphasized the importance of care in its preparation.

In presenting his paper showing where electric heat should be used in the foundry, E. F. Collins, General Electric Co., Schenectady, N. Y., suggested that it is possible for the malleable foundryman to cut down the cycle of the anneal from more than 120 hours to as low as 80, or even 70 hours, by the use of electrically heated annealing ovens. This he claimed could be done without increasing the total cost of the anneal and with assurance of an even product duplicated on each anneal through control.

Minimum Tensile Requirements for Cast Steel

CURRENT A. S. T. M. SPECIFICATIONS FOR STEEL CASTINGS

Kind	Tensile strength, pounds	Elongation, per cent	Reduction of area, per cent
B—Soft	60,000	22	30
B—Medium	70,000	18	25
B—Hard	80,000	15	20

(Yield point for all class B steels—45 per cent of tensile strength.)

PROPOSED A. S. T. M. SPECIFICATIONS FOR CARBON STEEL CASTINGS FOR RAILROADS

	Grade A Annealed	Grade B Annealed	Grade A Unannealed
Yield point	29,250 pounds	36,000 pounds	29,250 pounds
Tensile strength	Not specified	Not specified	Not specified
Elongation	1,600,000	1,600,000	1,450,000
	Tensile strength	Tensile strength	Tensile strength
Elongation not under	24 per cent	22 per cent	22 per cent
Reduction of area	2,600,000	2,500,000	2,250,000
	Tensile strength	Tensile strength	Tensile strength
Reduction of area not under	35 per cent	30 per cent	30 per cent

By using these formulae, tensile strength values as shown below would establish the minimum elongations and reductions indicated:

Grade A—Annealed			Grade B—Annealed		
Tensile strength, pounds	Elongation, per cent	Reduction of area, per cent	Tensile strength, pounds	Elongation, per cent	Reduction of area, per cent
58,000	27.6	44.8	70,000	22.8	35.7
59,000	27.1	44.0	71,000	22.5	35.2
60,000	26.6	43.3	72,000	22.2	34.7
61,000	26.2	43.1	73,000	22.0	34.2
62,000	25.8	42.0	74,000	22.0	33.8
63,000	25.4	41.3	75,000	22.0	33.3
64,000	25.0	40.6	76,000	22.0	32.9
65,000	24.6	40.0	77,000	22.0	32.5
66,000	24.3	39.1	78,000	22.0	32.1
67,000	24.0	38.8	79,000	22.0	31.6
68,000	24.0	38.2	80,000	22.0	31.2
69,000	24.0	37.7	81,000	22.0	30.9
70,000	24.0	37.1	82,000	22.0	30.5
71,000	24.0	36.6	83,000	22.0	30.1
72,000	24.0	36.0	84,000	22.0	30.0
73,000	24.0	35.6	85,000	22.0	30.0

JOURNEYED FAR TO ROCHESTER

L. Blackwood, chairman, board of directors, Hadfield's Australia, Ltd., Sydney, Australia, is a genial veteran foundryman

The report of the A. F. A. representative on the joint committee for the investigation of phosphorus and sulphur in steel, presented by R. A. Bull, was a general resume of the work of the committee consisting of representatives from a number of technical societies and government departments. The thoroughness of the work of the committee was illustrated by copies of the report on the effect of sulphur on rivet steel which were distributed. This report is based on approximately 5230 physical tests and more than 1000 chemical determinations. No recommendations were incorporated.

Details of the blow-torch design in open-hearth furnaces were described by Willis McKee, Arthur G. McKee & Co., Cleveland in the first paper presented at the Wednesday meeting of the steel session. In this furnace, the ports are so designed that the gas and air are completely mixed before entering the hearth so as to obtain complete combustion promptly. This, it is claimed resulted in increased thermal efficiency, greater furnace output, and more accurate control of melting temperatures. It also enables the operator to obtain higher temperature in the metal. Furnaces operating on producer gas are designed so that the gas may be taken hot from the producer to the furnace and therefore does not need preheating. In such furnaces all the gases of combustion are available for preheating the air.

In reply to a question by R. A. Bull as to the effect of the extreme heat of the flame on the roof Mr. McKee said that little excess roof trouble is caused by the flame, the main difficulty being encountered in the side and back walls. However, he said this is being lessened as the operators and the designing engineers become more familiar with the furnace.

NOW CONSIDER MARINE ENGINES

F. J. Cook, Rudge-Littley, Ltd., and James A. Murphy, Connersville Foundry Corp., draw comparisons

That repair welding should be under the supervision of the master mechanic rather than under a production manager was advocated by G. O. Carter, Linde Air Products Co., New York, in a managerial study of oxyacetylene cutting and welding in foundries. A thorough survey of the problem was given by Mr. Carter and in the discussion of the paper he advocated the use of a welding rod containing 0.65 per cent manganese and 0.80 per cent phosphorus to prevent burning out the carbon. R. A. Bull called attention to the fact that many welders insist that a pure iron is necessary to prevent included oxides in the weld but Mr. Carter said that clear welds are obtained by using the high-silicon rods.

J. R. Allen, International Harvester Co., Chicago, inquired whether malleable iron could be welded successfully and was told by the speaker that the best practice is to braze malleable castings with tobin bronze which gives a joint as strong as the original metal. Discussing the cutting of cast iron by the oxyacetylene flame, Mr. Carter said it was only profitable in exceptional cases as it costs approximately five time as much as to cut steel. However, in many cases even this high cost was said to be justified.

In the absence of W. A. Jannsen American Steel Foundries, Chicago, chairman of the committee on steel foundry standards, R. A. Bull read the report of the committee. The committee recommends the cancellation of the standards adopted by the association in order to co-operate with the work of the American Engineering Standard committee. F. D. Glosser, Marion, O., moved the report be accepted and the board of directors be asked to arrange for the co-operation of the association with the American Engineering Standards committee.

Sand Talks Excite Members' Interest

THAT the foundryman is awakening to the importance of his sand was manifested by the large attendance at the sand session held Thursday morning and continued at an extra session on Friday morning. R. A. Bull, who acted as chairman of the meeting, read the report of the joint committee of the American Foundrymen's association and the National Research council on the results of its molding sand research. Attention was directed to the fact that the work of this committee was made possible by the donation of $2500 by Thomas W. and John C. Pangborn and of $1000 by the National Engineering Co. H. B. Hanley, New London Ship & Engine Co., chairman of the subcommittee on standard tests, reported that standard tests have been developed and will be reported in detail shortly. Fred L. Wolf, Ohio Brass Co., Mansfield, O., chairman of the subcommittee on reclamation, said that the National Engineering Co., Chicago, has loaned a sand mixer to the committee and sand experiments will be undertaken shortly. That the subcommittee has endeavored to interest the state geologists in all the states and in the provinces of Canada was reported by Henry Reis, Cornell university, chairman of that subcommittee.

Discussion of these reports was entered into by many foundrymen and sand producers who emphasized the necessity of definite tests to determine the quality of sand and the desirability of buying sand on a quality basis from sand companies of established reputation who are endeavoring to supply the needs of their customers instead of purchasing sand on a strictly price basis. Eugene Smith, Crane Co., Chicago, said that by getting the proper sand and using it correctly the Crane company has cut down its requirements from 5000 tons in 1915 to 1500 tons in the past year, making approximately the same amount of castings.

Details of tests for determining bond strength of green sand are given in a paper presented by R. J. Doty, Sivyer Steel Casting Co., Milwaukee. Mr. Doty said the Sivyer company makes sand tests twice a day and find that they indicate the condition of the sand in time to make any necessary corrections before the sand deteriorates far enough to effect the castings injuriously. He pointed out the fact that sand changes gradually so that any trend may be noted by the sets and corrected in time. In reply to inquiry Mr. Doty said it requires four hours to make a complete test of sand as practiced by his company.

The meeting had to adjourn before all the papers were presented on account of the boat excursion and the in-

(*Concluded on Page* 515)

Equipment Marks Progress

Accomplishment in Foundry Lines Proceeds Despite Dull Period Passed
Character of Rochester Exhibition Shows Tendency Toward
Economy in Castings Production

EACH succeeding convention of the American Foundrymen's association has served as a milestone in the progress of castings manufacture. Since the first showing of foundry equipment at Cleveland in 1906, each development in the art, in the devices and innovations used for molding, melting, handling supplies and in the means for performing the multitude of separate foundry operations, has been displayed to the industry at these annual shows. Sixteen exhibitions have been held, the dark days of 1921 affording the single vacant date since the inception of the idea.

Since the Columbus show, in October, 1920, the manufacturers of foundry appurtenances have not been idle. The Rochester exhibition, although smaller in the point of floor space occupied, and evidencing, for this reason, some of the effects of the past business depression, surpassed every previous show in the general excellence of exhibits and in diversity of interest.

The general tendency toward smaller models of existing machines was evident. New ideas in molding machines were set forward; handling and charging equipment anticipated the labor shortage which is foretold by increasing foundry activity; and a greater interest and desire to serve on the part of manufacturers of miscellaneous supplies was marked. In fact those products which previously had been regarded as only tangent to the foundry industry were shown fully parallel in interest at Rochester and were demonstrated in a way to attract the foundrymen. A case in point was the

comparison of leather belting with other belting materials, through an operating motor, dynamometer set with a visual slippage gage. This was shown by the Leather Belting Exchange, Philadelphia, an association of manufacturers.

Three large buildings at Exhibition park were required for the exhibit. The first, which contained the registration headquarters served a number of metals, supply and precision instrument manufacturers. The second had a miscellany of supplies, equipment and rest-room features. The third was given over to the heavy operating exhibits, molding machines, furnaces, and cleaning room necessities.

American Foundry Equipment Co., New York, displayed several types of sandblast machines, including rotary table and tumbling barrels, a cloth screen type dust arrester and screen hopper-type sand blast tank. Three sizes sand cutting machines were in operation during the greater part of the time. Molds were made on a hand power, jolt, rollover, squeeze, pattern draw machine. This machine is an adaptation of the power operated machine of the same general type, but is provided with a long spiral spring on each side which is said practically to relieve the molder of load and to facilitate the production of molds with a minimum of fatigue. Two ramming tables are provided so that a complete 2-part mold is produced at each operation. Miscellaneous equipment display included corrugated steel flasks, aluminum taper snap flasks, pattern mounts and plates.

Hand and power molding machines

Uncle Billy Chambers

ANY exhibition of the American Foundrymen's association would seem incomplete without the genial presence of Uncle Billy Chambers. Yet he is far from being considered a part of the immovable scenery of this important event in the foundry industry as he always permeates and mingles among the foundrymen and manufacturers present, serving, unconciously, as a living reminder of the debt the foundry world owes to those pioneers who made the association a moving factor. Uncle Billy was a foundryman, forty or more yaers ago and in fact made some of the first steel castings ever produced, in a small foundry in Philadelphia. Later he was responsible for the start of the Chicago Crucible Casting Co., later sold to the Gould Coupler Co. Then he started plants in Mt. Pelier, Converse, and Peru, Ind. Many years ago, Uncle Billy entered the foundry sand business with the Garden City Sand Co., from which firm he resigned last year to enter a partnership with Henry Croxon in the Material Service Co., Chicago, sand, firebrick and building material representatives. Uncle Billy has been a consistent and helpful reader of THE FOUNDRY *since the first number was published Sept. 10, 1892.*

were shown in operation in the booths occupied by the Arcade Mfg. Co., Freeport, Ill. These included a new type jolter provided with a special, air-stripped squeezer fitted for making piston rings, a regular air squeezer, a combined jolt and squeeze machine and a plain jolter.

One corner of the building was occupied by two sand throwing molding machines made by the Bearsdley-Piper Co., Chicago. One tractor-type unit travelled back and forth on a short track, and filled flasks mounted on molding machines on each side of its line of travel. The other a stationary type machine swung on a central column and filled flasks on machines set in a circle within reach of the articulated arm and ramming head. This is the first time this type of machine has been shown at a foundrymen's exhibition and it attracted considerable attention.

Jolt rollover, pattern draw machines and plain jolt stripper machines were shown by the Davenport Machine & Foundry Co., Davenport, Ia. Six core making machines in which the sand is forced into the corebox by a jet of compressed air were shown in operation by Wm. Demmler & Bros., Kewanee, Ill.

Rollover jolt machines electrically operated with pattern draw electrically operated flask filling machines, several types of jolt squeezers, plain air squeezers, hand operated rollover machine and hand operated stripper machine were displayed by the Osborn Mfg. Co., Cleveland.

Henry Pridmore Inc., Chicago, showed a 10-inch draw combination, electric-jolt, power rock-over drop machine with mounted patterns, a 16 x 20-inch to 8-inch draw, combination, electric jolt, strip machine with mounted patterns and two hand operated 10 x 12-inch machines equipped with brake shoe patterns. Federal Malleable Co., West Allis, Wis., had several machines on exhibition including one equipped with a rapid air-operated pattern drawing device and stripping plate. The Hermann Pneumatic Machine Co., Pittsburgh, showed a working model of their rollover, pattern drawing, molding machine. The Grimes Molding Machine Co., Detroit had on exhibition a hand ram, rollover molding machine and also a power operated jar ram rollover molding machine with a lifting capacity of 2500 pounds.

Squeezer molding machines were shown by the Moline Iron Works, Moline, Ill., while several types of molding machines were shown by the Wm. H. Nicholls Co., Inc., Brooklyn, N. Y.

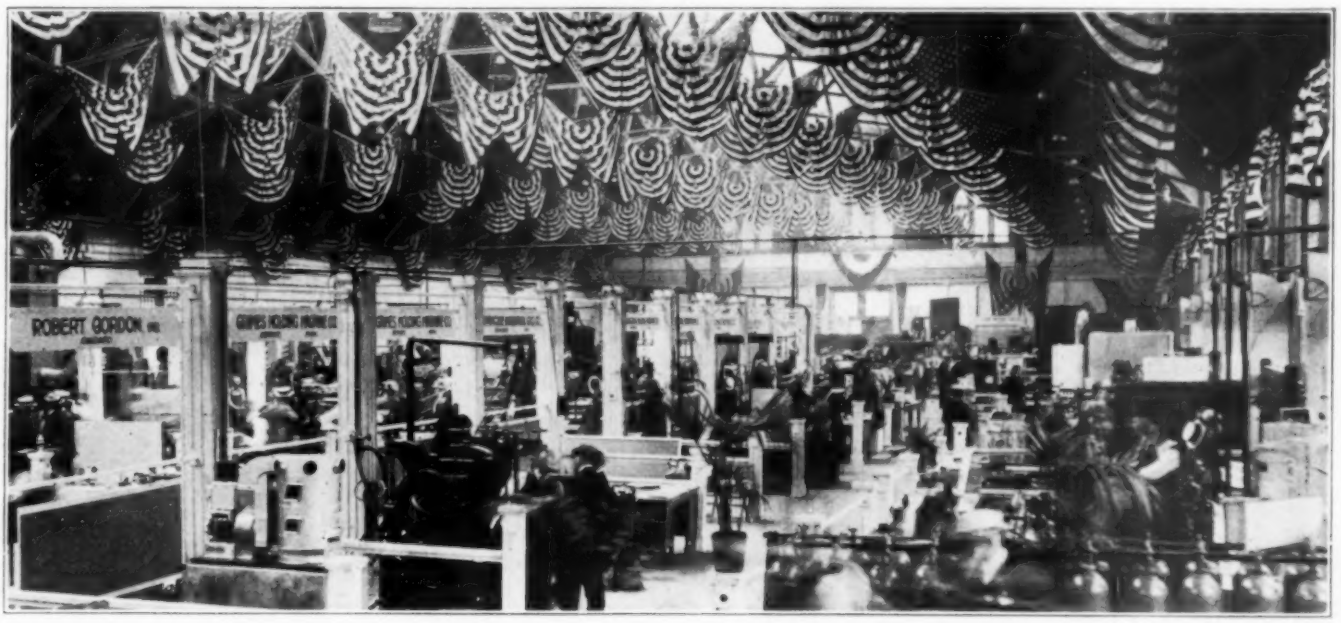
Combination power, rollover machines, combination jolt stripping machines, hand rollover and special machines for core making were shown by the International Molding Machine Co., Chicago. Wadsworth Core Machine & Equipment Co., Akron, had on exhibition a coremaking machine, a core cutting off and coning machine and various sizes of all steel core and bottom plates.

A new type molding machine of the combined jar and squeeze type, equipped with automatic control valves of an original design was shown by the Stoney Foundry Engineering & Equipment Co., Cleveland. It was provided with a small automobile engine cylinder pattern and was demonstrated during the period of the exhibition.

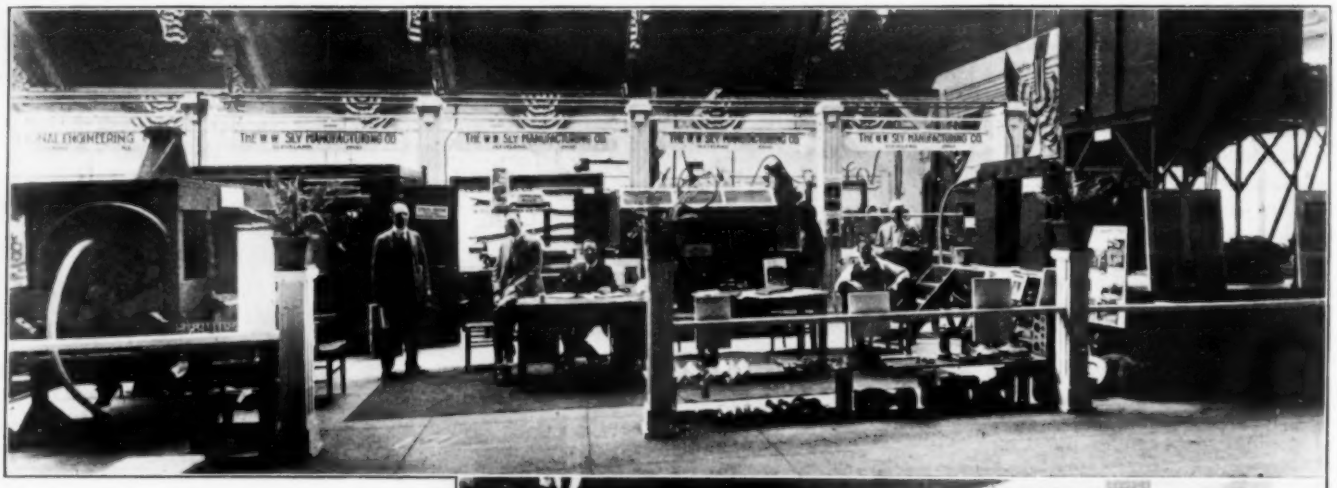
The Sterling Wheelbarrow Co., Milwauke, rigged a novel exhibit to demonstrate the durability of its barrows for foundry service. Supported by its handles and with the wheel resting on a rapidly revolving, power driven steel wheel having a number of rivetted lugs, a wheel barrow, loaded with 700 pounds of concrete was subjected to continuous jolting and stress. In addition to this the company displayed its rolled steel flasks.

An extensive display of sandblast equipment both stationary and in operation was shown by the Pangborn Corp., Hagerstown, Md. The list included an enclosed revolving barrel provided with baffle plates, a cabinet sandblast in which the operator inserts his arm through a rubber apron and directs the operation of the nozzle, a rotary table sand blast in which one half of the table constantly is exposed to the action of the abrasive, a sandblast room provided with a positive cross draft which carries all dust to the arrester and a new model dust arrester. Dustless, self contained, automatic sandblast machines, one, an 88-inch table machine and the other a 32 x 40-inch barrel machine in operation, a sandblast tank and an injector sandblast were shown by the Hoevel Mfg. Corp., Jersey City, N. J.

W. W. Sly Co., Cleveland, showed a complete sandblast room installation, provided with glass windows at various points so that the process could be observed at every point. In addition a tilted sand blast barrel, a sandblast cabinet, a horizontal sandblast mill, a core oven and a table of model tumb-



SPACIOUS AND WELL ARRANGED BUILDINGS AFFORDED AMPLE FACILITIES FOR THE EXHIBITS

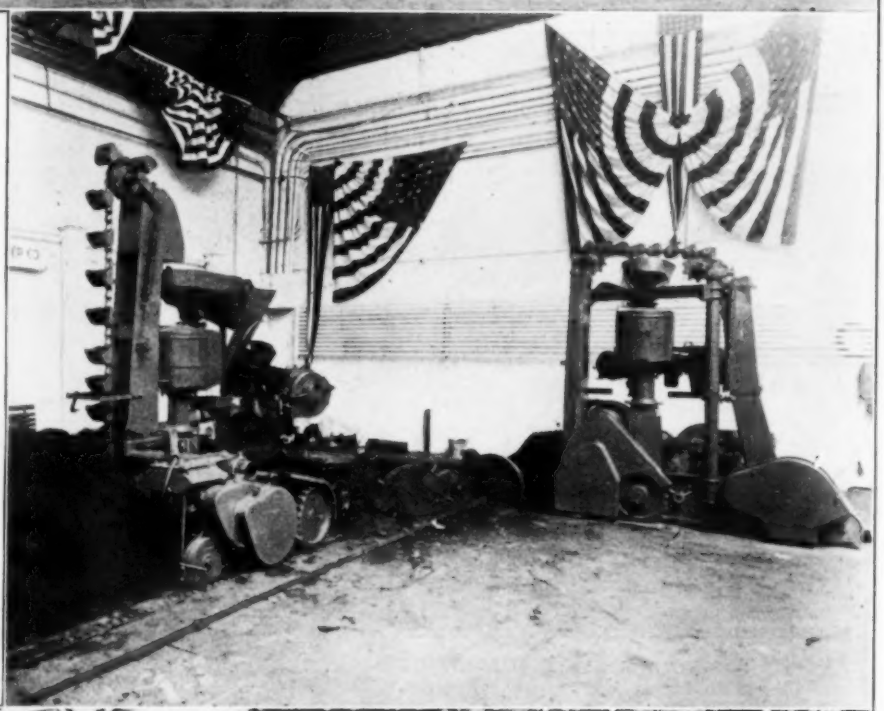


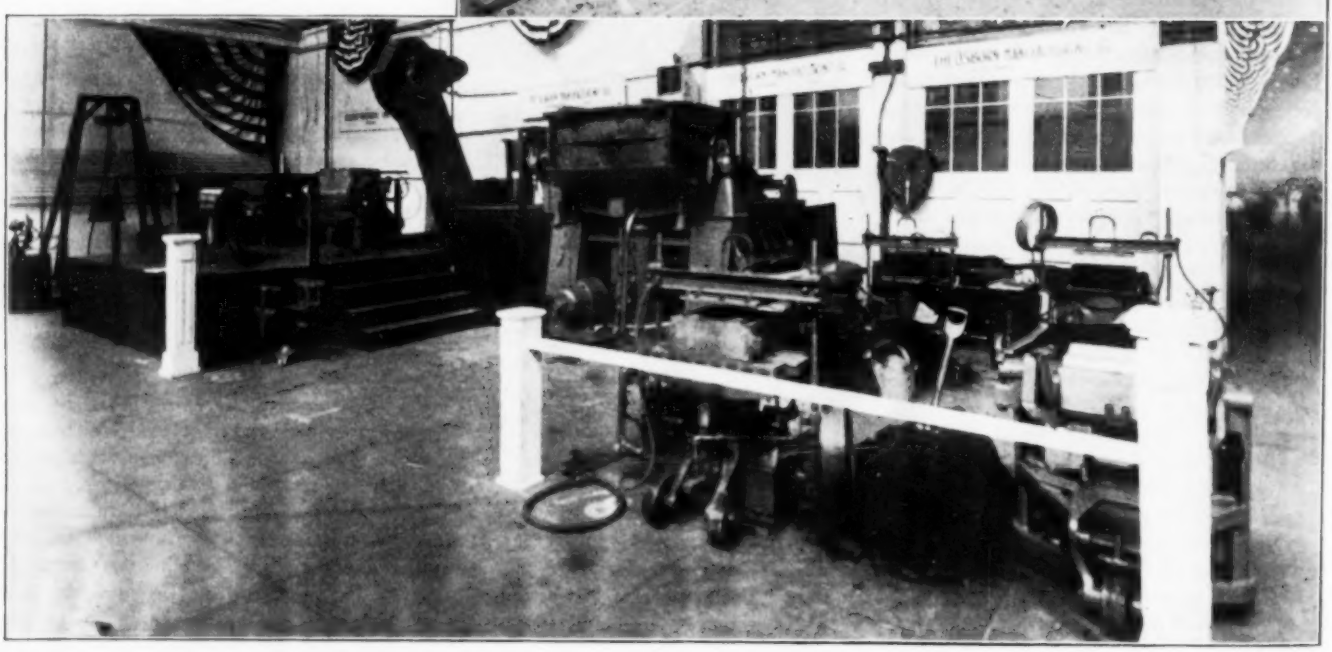
BOTH OPERATING AND STATIONARY DISPLAYS WERE GROUPED IN THE VARIOUS BUILDINGS

ling barrels were displayed. Sandblast tumbling barrels, a sandblast hose machine, a model of a dust arrester and oil burning equipment were on exhibition in the booth of Macleod Co., Cincinnati. The Northern Blower Co., Cleveland, displayed two types of dust arresters, a sandblast room, blow pipes and blower.

In addition to a number of glass jars containing samples of the various sizes of chilled shot, a number of castings illustrating their relative appearance before and after cleaning were shown by the Globe Iron-Crush and Shot Co., Mansfield, O.

George Oldham & Sons Co., Baltimore, had an interesting exhibit of chipping hammers, foundry rammers and core breaking equipment. Three





RECENT TYPES OF MOLDING MACHINES AND NEW ADAPTATIONS OF STANDARD MODELS WERE IN EVIDENCE. WORKING ON THE FLOOR OF BUILDING NO. 5

rammers were mounted and driven in temporary guides in a box containing a quantity of sand to illustrate operating conditions. A working demonstration of a flask guide was given at the booth occupied by the representative of the B. & J. Co., Springfield, O.

Two ornamental lamp standards marked the entrance to the exhibit shown by the Carborundum Co., Niagara Falls, N. Y. which included practically every conceivable shape and size of grinding wheels, disks, paper in rolls, cupola blocks and refractory sand for daubing. Many photographs of varied types of installation tended to give the booths an attractive appearance. The exhibit of the Combined Supply & Equipment Co., Buffalo, was confined mainly to an extenisve display of double and angle stem chaplets.

Electric furnaces both for ferrous and nonferrous metals are such a comparatively recent development in the foundry that even the oldest applications seem new to many foundrymen. This made the exhibits of some half a dozen electric furnace manufacturers doubly interesting to the visitor at the exhibition. However, practically all of the firms exhibiting in this line had new developments, some of which are highly promising. The Ajax Metal Co., Philadelphia, showed an induction type furnace recently developed. The secondary of this type furnace is vertical instead of horizontal as in the case of induction furnaces previously designed. Another unique feature of this furnace is that it can be operated direct on a 25 or 60 cycle circuit. Also, it is claimed that the furnace operates on a power factor of 80.

The company had two of these furnaces on exhibition, the larger with a capacity of 600 pounds of metal in the bath and operating on 60 kilowatts. The other furnace which was in operation was a miniature with a capacity of only a few pounds, loaned by the Bridgeport Brass Co. The body of this furnace was made of wood so that only low melting point metals could be melted in it. At the exhibition a bismuth alloy with a melting point of 150 degrees was melted.

The Ajax exhibit also included a high frequency furnace made by the Ajax Electrothermic Corp., Trenton, N. J., a subsidiary of the Ajax Metal Co. The function of this furnace is to melt small quantities of precious metal in a graphite crucible, or for research work with either steel or iron. The furnace is so small that it can be carried about by two men, and so acts as a ladle when the metal is melted. While nearly all metals can be melted in it, using a graphite crucible, a lime or magnesia crucible must be used when platinum is melted.

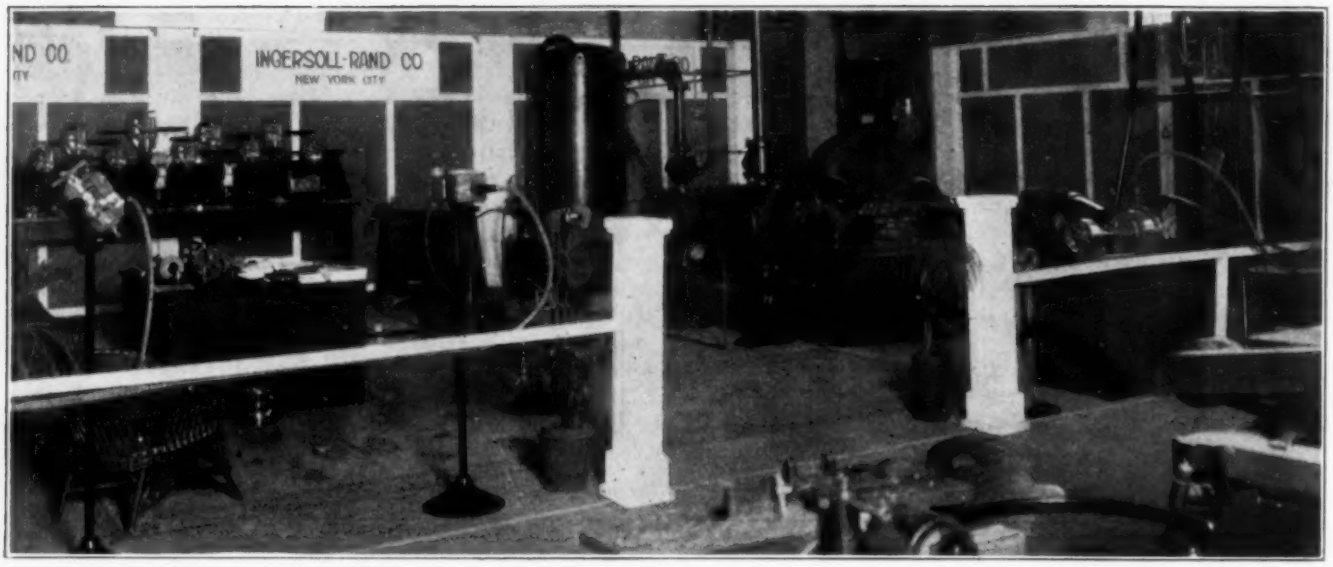
A later form of the Collins smothered arc furnace was shown by the General Electric Co. In this furnace the metal is melted in a crucible, heat being supplied by two smothered arcs, one on each side of the crucible. A No. 20 crucible is used for melting either brass or aluminum. A pyrometer in the roof indicates the temperature at that point, which is between 25 and 30 degrees above that of the metal. The furnace was shown complete with an automatic control panel and transformer, and was in operation during the exhibit. The company also exhibited a portable semi-automatic arc welding unit operated by a 200-ampere portable motor generator set with the necessary starting and control panel. This set was demonstrated by welding miscellaneous castings.

While the Detroit Electric Furnace Co., Detroit, did not have a working exhibit, visitors to its booth were referred to the plant of Sarachan & Rosenthal Inc., Rochester, to see a 1-ton furnace made by the Detroit company, in operation. The exhibit of this company included gated castings poured from electric furnace brass. Photographs of furnaces installed by the firm also were shown and literature was given to visitors.

Metal was melted in a 255-kilowatt furnace by the Electric Furnace Co., Alliance, O. This furnace has a hearth capacity of 250 to 300 pounds and is equipped with a pyrometer in the roof from which the temperature of the metal may be differentiated, as the temperature of the bath is alwaye approximately 200 degrees below that of the roof. The furnace was complete with switchboard, transformer and meters.

The Pittsburgh Electric Furnace Corp., Pittsburgh, had an exhibit of castings made from metal melted in a furnace built by that company, and also showed photographs of installations. Castings made from electric furnace iron also were shown by the W. P. Taylor Co., Buffalo, which exhibited castings made in its foundry

A TENDENCY WAS EVIDENT TO ADAPT EQUIPMENT TO THE VARIED NEEDS OF THE SMALL AS WELL AS THE EXTENSIVE FOUNDRY—MANY NEW TYPES WERE SHOWN



SMALL AIR OPERATED TOOLS, AS WELL AS HEAVY COMPRESSOR EQUIPMENT WERE SHOWN IN PROFUSION

from metal melted in a 3-ton heroult furnace.

New developments in fuel-fired furnaces were shown by the Monarch Engineering & Mfg. Co., Baltimore. These included two small cupolas. The one, which has a capacity of 2000 pounds per hour, was lined to 15 inches inside diameter and was arranged so that it could be tilted for relining. No slag spout is provided in this cupola and therefore the length of the run is limited. It is dumped by opening doors on the bottom. The second cupola is still smaller, being only 5 feet high and having a capacity of 250 pounds per hour. This is lined to 9 inches inside diameter. Air is preheated by being passed through a jacket around the brick lining before being blown through the tuyeres. This cupola is intended for small jobbing shops and for experimental work in larger foundries.

A newly designed oil burner was another interesting feature of the exhibit of the Monarch company. The oil is given a spiral movement and comes from the needle valve in the form of a hollow column when it meets air under pressure which atomizes it. Around this air outlet is another pipe which feeds air for combustion at a lower pressure. It is claimed that the combustion is so well regulated that anywhere from 2 to 15 gallons may be successfully burned per hour. The company also features preheating in gas and oil furnaces, as well as in the small cupola, and exhibited a combination oil or gas burning furnace in which the air is preheated in a double shell around the lining of the furnace.

The Wayne Oil Tank & Pump Co., Fort Wayne, Ind., exhibited a pit-type crucible melting furnace equipped with a preheater, a portable wheel tank for core oil and other equipment. Photographs, drawings and technical data on metallurgical furnaces were shown at the booth of Holcroft & Co., Detroit, and the Bonnot Co., Canton, O., distributed informational data on powdered coal equipment and grinding machinery.

Much interest was shown in exhibits of blast gages. These have been shown at other foundry exhibits but the average foundryman does not appreciate their value. However, more are coming to realize the importance of of knowing the exact volume as well as the pressure of the air which is being blown into the cupola. The Bacharach Industrial Instrument Co., Pittsburgh, had a display of pressure and volume measuring instruments, and illustrated their operation, using a pipe through which air was blown by a fan. A new instrument was shown which gives on the same chart a graphic record of both pressure and volume of air delivered. More simple indicating instruments for measuring pressure and volume also were exhibited. In addition to the pressure and volume gages a gage was shown for indicating the percentage of carbon dioxide as an indication of the state of combustion in the cupola at any one time.

WELDING AND CUTTING APPARATUS SHOWED MARKED ADVANCES SINCE THE LAST SHOW

Volume meters which must be calibrated according to the sizes of pipe on which they are to be used, were exhibited by the Charles J. Clark Blastmeter Co., Gladbrook, Ia. The company also showed gages which indicate the velocity of the air, for use in calculating the volume of air passing through any size pipe. A number of pressure gages were included in the exhibit.

Several firms gave demonstrations of cutting cast iron with the oxyacetylene flame which is not yet thoroughly understood by the foundryman, as was indicated by the interest shown. One of the firms having such an exhibit was the Air Reduction Sales Co., New York. This company also showed automatic oxyacetylene welding and cutting machines of different types as well as hand welding and cutting torches for welding gray iron, steel and brass castings, and for cutting cast iron and steel, including many of the machines formerly manufactured by the Davis-Bournonville Co., which recently was combined with this company. The exhibit also included a portable acetylene generator with a capacity of 100 pounds of carbide and generating at the rate of 100 cubic feet of gas a minute.

Cutting of iron by the oxyacetylene flame also was shown by the Oxweld Acetylene Co. Newark, N. J. which had a complete line of cutting and welding equipment and torches, including an oxyacetylene generator. This was of the duplex type which can be operated without interruption for filling as one side only need be filled at a time, while the other side generates gas. Each side has a capacity of 100 pounds of carbide. The Bastian-Blessing Co., Chicago, had an interesting exhibit of welding and cutting equipment and safety regulators.

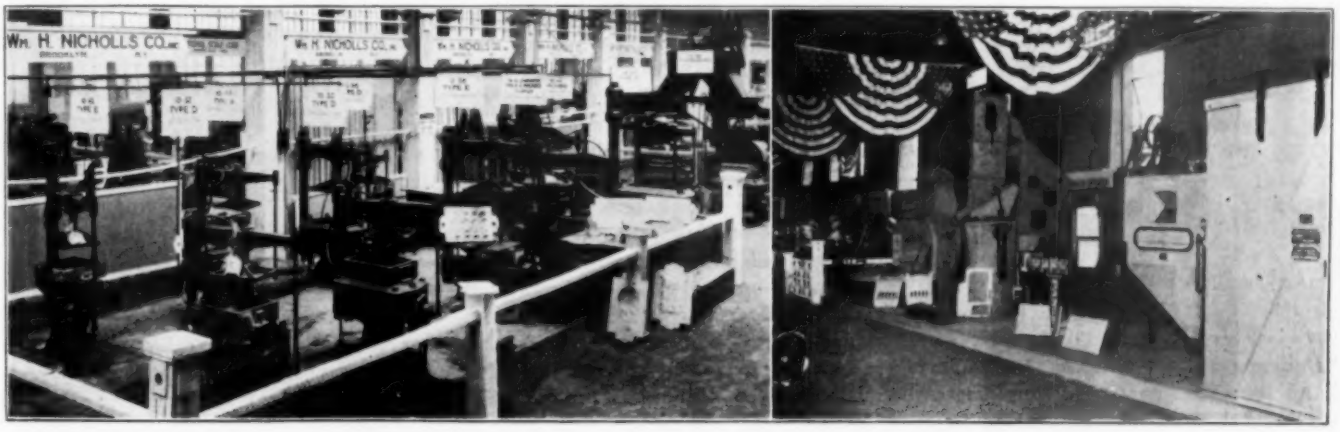
Another form of welding was illustrated by transparencies and photographs by the Metal & Thermit Corp., New York, which controls the thermit welding process. This company also exhibited samples of the many alloys which it makes including manganese copper, nickel, copper, manganese aluminum, manganese titanium, manganese boron and the ferroalloys such as ferrotitanium and ferrotungsten.

BOTH UTILITY AND GOOD TASTE WERE EVIDENT IN THE ARRANGEMENT OF MANY OF THE EXHIBITS

Pyrometers, both indicating and recording were exhibited by the Taylor Instrument Co., Rochester, N. Y., and the Leeds & Northrup Co., Philadelphia. Both of these companies offered instruments for determining temperature of molten metal in the furnace including steel which has offered considerable difficulty to this on account of its high melting point. The Taylor companies showed the newest type of Fery radiation pyrometer and the Leeds & Northrup Co., exhibited an optical pyrometer which is used in a number of steel mills. The latter company included in their exhibit an electrical resistance furnace for calibrating pyrometers. An automatic temperature control equipment for gas and electrically heated core ovens was shown by the Taylor company.

The metallurgist was interested in the complete display of microscropes and magnifiers by the Bausch & Lomb Optical Co., Rochester. One set was equipped with an inverted microscope and lighted with a 6 volt, 108 watt special concentrated filament lamp.. This company also exhibited samples of optical glass.

Since the last exhibition, little incentive has been offered to develop new ideas in plant construction, due to the blighting influence of the business depression. Despite this fact a number of nationally known firms which specialize in designing and constructing foundries were exhibitors. These included the Austin Co., Cleveland, with a photographic display; Frank D. Chase, Inc., Chicago, which showed plans and photographs of foundries; Clement A. Hardy, Chicago, with plans and illustrations of industrial plants; H. M. Lane Co., Detroit, with prints of plants; and Mills, Rhines, Bellman & Nordhoff, Toledo, with layouts and photographs of new and remodeled shops. Lighting and ventilation for foundries found sponsors in David Lupton's



VARIETY WAS NOTED IN THE TYPES OF MANY CLASSES OF EQUIPMENT AND THE EFFORT TO ADAPT EQUIPMENT TO VARIED NEEDS WAS PRONOUNCED

Sons Co., Philadelphia, the Truscon Steel Co., Youngstown, and the E. F. Hauserman Co., Cleveland, through the display of steel sash, skylights and compact steel shelving and handling containers.

Cranes and hoists, those indispensable servants in modern foundry operations were more than ever in evidence. Developments of existing ideas and innovations which have been evolved since 1920 were noted. P. H. & F. M. Roots Co., Connersville, Ind. have entered the field of handling equipment with a new cupola charging machine. This device is a self-contained telpher monorail hoist, with a cantilever arm extending forward to enter the cupola door, carrying a magnet with an iron charge or with a bottom drop bucket for the other materials which make up the cupola burden. This unit will carry a maximum of 800 pounds of iron, picking it up in the yard or from the charging floor. In the latter instance, it is stated that 30 tons an hour may be charged. With its double-truck, four wheel support, driving through the front trucks, it is stated that the machine can travel up a 12 per cent grade with a maximum load.

Heavy cranes, due to the limiting features of space and erection difficulties largely were shown through photographs and drawings. Firms which used this method of demonstration were the Cleveland Crane & Engineering Co., Wickliffe, O., which also had full size electric hoists, one with a self-contained control platform of simple design; and the Whiting Corp., Harvey, Ill. which in addition to its display of a full size sand cutting machine, drawings and photographs of the Grindle type pulverized fuel systems and a miscellany of light equipment, demonstrated a working model of a heavy crane trolley.

Light hoists of all types were strongly in evidence. These ranged from simple chain blocks operating on monorails to the most modern development in electric units, and a number actuated by pneumatic power. The Shepard Electric Crane & Hoist Co., Montour Falls, N. Y. displayed four types, all mounted and in operation. Richards-Wilcox Mfg. Co., Aurora, Ill., demonstrated trolley and I-beam type hoists, switches, cross overs and trolleys, both hand and power operated. The Link-Belt Co., Chicago, showed electric hoists in addition to a sand revivifier and illustrations of sand handling and preparing machinery. Sand handling, continuous molding and mechanical carrying equipment composed the exhibit of C. O. Bartlett & Snow Co., Cleveland.

That which might be termed the humane side of foundry operation was strongly represented by manufacturers of heating equipment for shops, notably Robert Gordon, Inc., Chicago, and Skinner Brothers Mfg. Co. Inc., St. Louis, together with those makers of safety and protective devices such as the Julius King Optical Co., New York, and the Safety Equipment Service Co., Cleveland.

Equipment which by strict classification is designated as machine tools did not play as prominent a part in this year's exhibit as in former years. Most of the machines designed for metal working purposes were displayed by tool jobbers of Rochester and Syracuse, N. Y. The largest exhibit was shown by the Syracuse Supply Co., Syracuse, N. Y. In the large booth maintained by this company were lathes, drills, shapers and millers manufactured by nationally known machine tool builders. A universal shaper and a vertical miller built by Kearney & Trecker, Milwaukee; a sensitive drill press made by the Edlund Machinery Co., Cortland, N. Y.; and a new type of production lathe developed by Porter-Cable, Syracuse, N. Y. were among the tools exhibited under power by the Syracuse jobbers. One feature of this company's exhibit was a group of six tools built by the American Tool Works Co., Cincinnati.

The numerous exhibits of grinding machinery indicates that the use of abrasives is being extended in the foundry industry. Several two-wheel grinding wheels stands were exhibited by the American Wood Working Machinery Co., Rochester, N. Y.; while portable ginders were shown by the Chicago Pneumatic Tool Co., Chicago; Cleveland Pneumatic Tool Co.; R. G. Haskins Co., Detroit; and the Independent Pneumatic Tool Co., Chicago.

A nonferrous exhibit of interest was that of the Ajax Metal Co., Philadelphia consisting of a display of ingot metals, castings made to illustrate the possibilities of the ingot, and bearing alloys. S. Birkenstein & Sons, Inc., Chicago, exhibited ingot metals, and castings made of the same. Balbach Smelting & Refining Co., Newark, N. J. although an old established concern exhibited for the first time at the foundry convention, showing copper, brass ingots, lead, white metal, blue vitrol, gold, silver, platinum and palladium. White & Bros., Inc., Philadelphia, showed metals in ingot form comprising composition and yellow ingot brass, manganese bronze, casting copper and white metals. To illustrate the possibilities of the ingot metals in casting, a statue of an Indian horseman, cleverly executed, was displayed.

Obermayer Prize Awarded

OUT of the eight foundry devices submitted in competition for the Obermayer prize at the Rochester show as photographs, blueprints, working models, or actual samples, the committee appointed by C. R. Messinger, president elect of the American Foundrymen's association, selected that offered by Edwin Jory, National Transit Pump & Machine Co., Oil City, Pa. The device may be adapted for the production of various types of castings, but in this particular instance was fitted up for making 3-way valves entirely in green sand. Briefly, the greensand core is made in a split box, one half of the corebox is removed, the drag part of the mold is inverted, attached to the remaining half of the corebox and both mold and core are rolled over, the remaining half of the corebox then is removed and the cope half of the mold is set in place on the drag. The other exhibits included an adjustable clamp, a hand operated jolting machine, a compression type corebox, a crane gong, a gear and worm pouring device to be attached to the ladle bail, a cupola reservoir and a mold jacket designed to eliminate the use of slip jackets, bands and snap flasks.

Will Represent Crane Building Company

A. F. Anjesky has been appointed representative of the Cleveland Tramrail division of the Cleveland Crane & Engineering Co., Wickliffe, O. Mr. Anjesky formerly represented the Cleveland Crane & Engineering Co., with offices in 50 Church street, New York City, in charge of cranes. He will be succeeded by L. F. Salom, New York representative of the tramrail division, and who will nevertheless continue this connection.

Elects New Officers

At a meeting of the board of directors of the Air Reduction Co. held May 24, 1922, A. R. Ludlow, formerly vice president in charge of sales, was elected first vice president; M. W. Randall, formerly secretary, was elected vice president and secretary; Herman Van Fleet, formerly chief engineer, was elected vice-president and operating manager; Dr. F. J. Metzger was elected vice president in charge of research and development.

Eulogizes British Foundry Iron

Higher Strength of British Cast Iron Claimed—Lower Temperature of the Blast Used in Smelting Advanced as a Cause—Shock Test Is Described

BY F. J. COOK

RIGHTLY or wrongly, the average British engineer and foundryman considers that American gray irons of their respective class are inferior in physical properties to those of Great Britain. He bases this opinion, first of all, upon the undoubtedly poor wearing qualities of the cast iron which some years ago formed the material of the large quantities of machine tools sent to England. It was commonly said that the cast iron was so soft as to be easily cut with a pocket knife, a statement often enough literally correct.

Recently, some improvement has been noticed, attributed partly to wider bearing surfaces and the application of chills on wearing parts, combined with the use of semisteel. Nevertheless experiences are still related, in connection with the war, showing that American material frequently left a good deal to be desired. The author was familiar with an American machine supplied by a well-known maker which was commandeered by the government for a special operation in connection with parts for large guns.

Owing to the poor quality of the cast iron the machine was constantly breaking down. No fault could be found with the design which was excellent for its specific requirement; yet owing to the long periods when it was out of commission through breakdowns the output was less than that obtained from an improvised old machine. It was necessary to replace the broken parts with castings produced from local irons utilizing the broken portions for patterns. These substituted parts proved quite satisfactory, and there was some foundation for the statement, although not strictly and literally true, that the only part remaining of the original cast iron in the machine at the end of the war was the name plate on the bed.

Internationalizing Idea

RECIPROCAL relations between the Institution of British Foundrymen and the American Foundrymen's association were inaugurated in 1921, when a paper by George K. Elliott of the latter society was presented and discussed at the meeting of the institution. This year marks the first presentation of a paper representative of the foundry industry in Great Britain. The accompanying article, prepared by F. J. Cook, representing the Institution of British Foundrymen, is the paper which was read at the Rochester convention of the American Foundrymen's association, June 5 to 9. One week later, a paper by Enrique Touceda on American malleable iron practice will be presented at the Birmingham meeting of the institution.

F. J. Cook is a prominent figure in the foundry industry in Great Britain. He is past president of the Institution of British Foundrymen, and is manager of Rudge-Littley, Ltd., West Bromwich, near Birmingham, England.

Cites Iron Failures

Writers of scientific papers in America frequently refer to the failure under superheated steam of cast iron parts. This is a state of affairs unusual in England, gray iron castings being made here without difficulty sufficiently strong to withstand working temperatures and pressures quite equal to those under which American castings have broken down. The composition of this more durable material being not widely different from the American irons which have proved unsuitable.

Some years ago an American technical journal with which the author was familiar regularly gave reports of burst flywheels, until at last it became quite natural to look for them with much the same amused interest as the readers of *Punch* anticipated the historical cartoon. English engineers regularly engaged in designing cast iron flywheels up to a weight of 56,000 pounds having periphery speeds of not less than 100 feet per second sometimes wondered as to the character of the remarkable material of which the American wheels were made.

Travel naturally widens one's views and extends one's knowledge, and conversely, there is a tendency on the part of the stay-at-home to become parochial and narrow. One of the results of the war has been a more frequent interchange of visits and we on this side from a period shortly before the end of the war consider ourselves specially favored in the visits we have received from many leading American foundrymen, whose eminence consists not only in foundry knowledge but in general accomplishments.

We hope they will pardon the amusement we have derived from the very candid opinions they have expressed in regard to us and our institution in the old days before, like the Queen of Sheba, they came to see for themselves. One American, for example, expressed the belief that British foundries were generally so badly lighted than an electric torch was necessary to find one's way about in them; moreover the molding shops

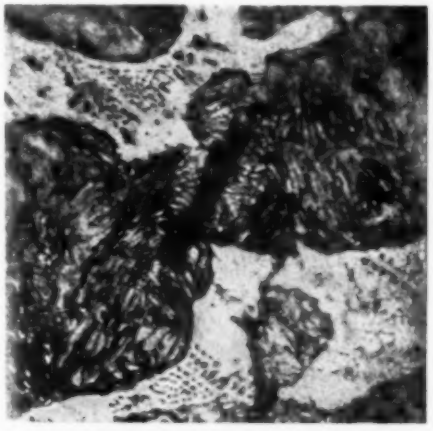


FIG. 1—MATRIX CONSISTING OF WELL DEFINED LAMINATED PEARLITE

FIG. 2—NOTE CEMENTITE AND SMALL FLAKES OF GRAPHITE

Table I

Results of Tensile Tests

Total carbon	Analysis C. C.	G. C.	P.	Si.	S.	Mn.	Tensile test result, lbs. per sq. inch	Transverse test equivalent, lbs. per sq. inch on Arbitration Bar
3.054	0.98	2.074	0.974	1.213	0.146	0.324	32704	5146
3.054	0.84	2.214	1.046	1.166	0.136	0.432	32720	5146
3.3	0.89	2.410	1.140	1.40	0.134	0.453	36064	5146
3.163	0.665	2.498	1.186	1.40	0.136	0.465	39200	5373
3.272	0.84	2.432	0.981	1.143	0.137	0.288	41440	5562
3.21	0.72	2.49	1.2	1.49	0.126	0.420	44486	5600

were so low that one had to be careful not to knock his head against the roof girders was candid enough to say that the first British molding shop he entered fairly took away his breath. After spending the whole afternoon in it he regretted his inability to stay longer and see more. He discovered that he had only seen a small part of the whole, and was a little surprised at the offer of his guide that "any time he had a week to spare they would be pleased to show him the remainder." As a matter of fact he was in the largest foundry in the world, and had no idea that so fine a concern could be found on this side of the Atlantic.

The author has to admit that up to the present he has been among the stay-at-homes and is quite prepared to find that his references to American practice will furnish foundrymen on the other side of the Atlantic with at least as much amusement as Britishers have derived from Americans and their opinions of Great Britain. The great purpose of the paper, however, is to furnish a basis for a good discussion and it may be hoped that this object will realized.

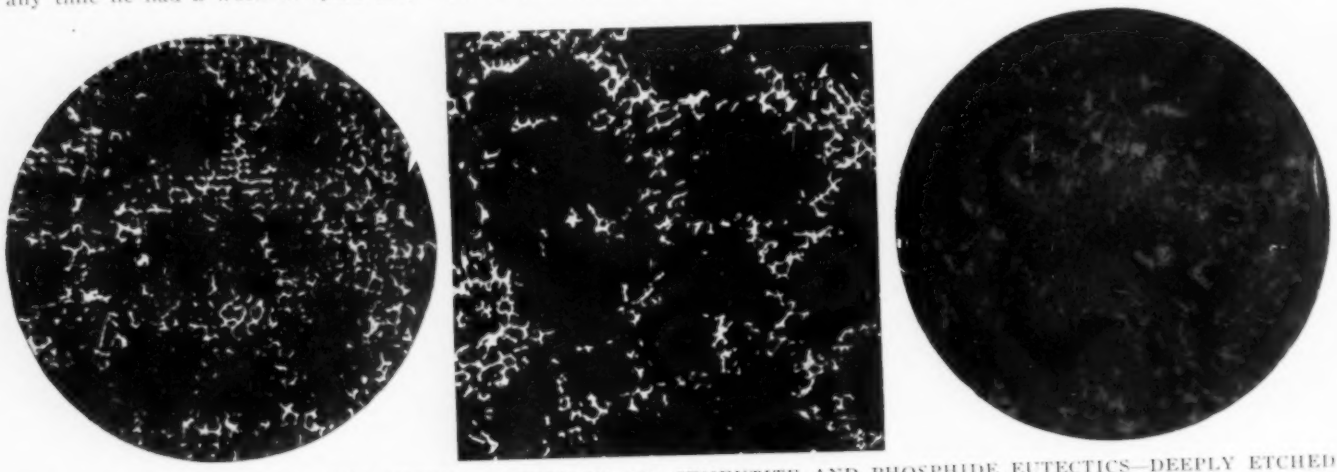
As the subject of gray cast iron obviously is too wide to be dealt with in a single paper, it is proposed to limit its scope to the consideration of gray cast iron made from commercial pig irons, and cast iron scrap melted in a cupola by means of coke, and without the addition of steel or any ferrous or nonferrous materials introduced either into the cupola or the ladle of molten metal.

Conditions of Test Vary

When one comes to deal specifically with mechanical tests the fact has to be faced that the conditions relating to mechanical tests for cast iron vary considerably in the two countries. Little importance appears to be attached in America to tensile testing, while the size of the transverse bars tested differs widely from British practice. The ruling tests for cast iron may be said to comprise in Great Britain; For pipes, constructional and general engineering work for more or less rough and large character, transverse bars, 2 inches deep 1 inch thick and tested deep part down on centers 3 feet apart; for engine details other than cylinders, transverse bars 1 inch square tested on centers 12 inches apart. It is also becoming more general in the finer classes of engine work to cast the transverse bars 1¼ inches square, machining down to 1 inch square to insure accuracy. For cylinders of all descriptions tensile bars exactly of the same material as the castings they are to represent are demanded. Practically every tensile bar has to be tested in the presence of an inspector, and the casting of the bars on the job therefore, generally gives more satisfaction and prevents the suspicion which might possibly arise if the bar was separately cast without the presence of the inspector. There is a great deal also to be said in favor of the tensile test for cylinders, since the castings themselves are necessarily subjected to tension. Moreover a tensile test gives a better indication of the wearing properties of this class of iron than any other test known to the author.

It may possibly be that the apathy with which the tensile test in America is regarded may to some extent be due to certain conditions named by Dr. Moldenke, though of that, of course, the author is not in a position to judge. Dr. Moldenke says*

"In this country (America) you will find about 99 out of 100 testing machines that are not in proper condition for the tensile test. On the other



FIGS. 3, 4 AND 5—MICROGRAPHS SHOWING NETWORK OF CEMENTITE AND PHOSPHIDE EUTECTICS—DEEPLY ETCHED WITH 20 PER CENT NITRIC ACID IN WATER AS SUGGESTED BY STEAD

Table II

Keeps's Tests on Cast Iron

Shrinkage inches	Transverse Breaking Load in pounds	Deflection inches
0.146	550	0.14
0.161	600	0.15
0.157	650	0.18
0.158	675	0.19
0.159	700	0.21
0.161	800	0.23

Thirty tests on this same size bar gave an average breaking load of 622 pounds.

*American Foundrymen's association, *Proceedings*, Volume XXII, page 368.

side they calibrate the machines often, and they have their governments to test them."

There can be no gainsaying his further statement on the same page that "for scientific investigation the tensile bar is preferable."

The reading of American scientific papers and of the technical press conveys the impression that a tensile test going a little beyond 31,360 pounds is considered worthy of special notice; certainly in this country anything like this would be considered quite mediocre. Mr. Ernest Wheeler,** representing Messrs. Crossley Bros. Ltd., Manchester, states that he has found it "quite possible, with out the aid of steel to prepare and obtain mixtures of cast iron having a tensile strength of over 18 tons (40,320 pounds) per square inch, and this is confirmed by other workers in the same field. The same gentleman has prepared for the author a bar cast in accordance with the specification for the "Arbitration bar" which has given a result of 39,200 pounds.

Tensile Tests

A short time ago the author tabulated his average tensile test results over a working period of 500 consecutive days. The average figure was 36,288 pounds per square inch; no test was as low as 30,240 pounds, while the highest figure reached was 43,008 pounds. All the bars were 1¼ inches diameter and were cast on the castings they were to represent—not separate—and were turned down in the middle to ½-square inch area before testing. A typical range of tensile test results with this class of iron with the accompanying analyses is given in Table 1.

For mechanical tests to be strictly comparable it is essential that the bars should be of the same dimensions and similarily molded, gated, cast and tested. It may be argued therefore that the tensile test results given in Table I are not comparable to those obtained by the American arbitration bar. But the author suggests that in this respect the advantage has not been with those cited. The bars were of the same dimensions as the arbitration bar, and they certainly had the advantage of static pressure due to casting head, as they are placed on the middle joint of short stroke cylinders. They have one disadvantage however, in that they were cast with cooler metal than if they had been cast from a small ladle direct from a cupola, while the rate of cooling is slower, owing to their having been cooled down in close proximity to a larger body of metal The disadvantages of all these conditions were well set out in the admirable exchange paper presented by George K. Elliott to the Institution of British Foundrymen last September.

Comparisons between the transverse tests made in the two countries are necessarily hampered by serious difficulties, chiefly on account of the difference in shape and dimensions of the bars used. The arbitration bar has a diameter of 1¼ inches and is tested as cast, on centers 12 inches apart. The bars with which the author is familiar and of which particulars are given later are cast 1¼ inches square, machined down to 1 inch square, tested on 12-inch centers, and cast on to castings, as previously defined in connection with the tensile test.

Constant Necessary

In the absence of an available machine suitable for taking a bar of 1¼ inches it has been necessary to evolve a constant which will reconcile the differences of dimensions in the two bars.

The results of the arbitration bar can be converted into those comparable for a 1-inch square bar tested on the same center by multiplying the breaking load obtained by 0.74; conversely the result obtained on the 1-inch square bar divided by 0.74 will give the equivalent load in the arbitration bar. The formula used for obtaining this factor is given in the appendix to this paper.

In the discussion on Mr. Elliott's paper already referred to, the author gave some details of 25 transverse tests of bars giving an equivalent average breaking load on an arbitration bar of 5300 pounds; the lowest bar gave an equivalent load of 5146 pounds and the highest 5600. The minimum load is a higher figure than that obtained by Mr. Elliott with American metal hav-

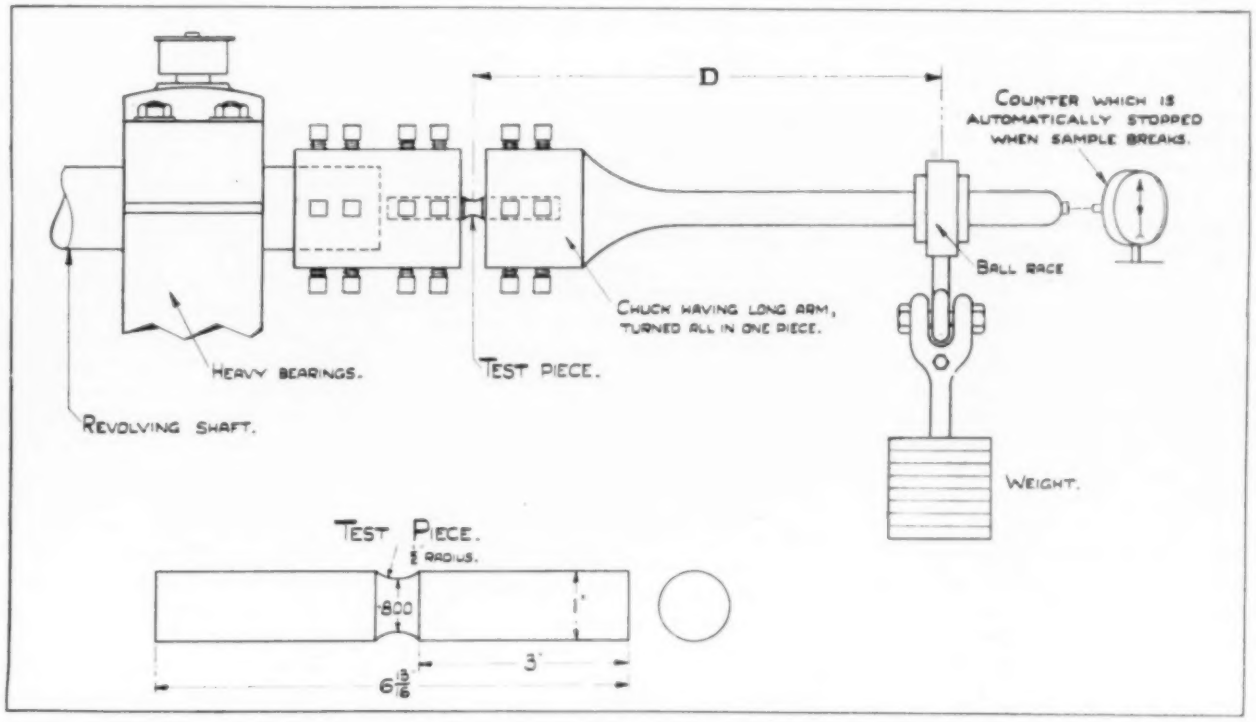


FIG. 6—DETAILS OF THE METHOD OF APPLYING THE ROTARY FATIGUE TEST, AND DIMENSIONS OF THE TEST BAR

**Manchester Association of Engineers, *Proceedings*, 1921.

Table III

Results of Chemical and Physical Tests

Chemical analysis	Tensile strength, pounds per square inch	Rotary fatigue test results: Revolutions per minute	Fiber stress tons per sq. in.	Total number revolutions to produce fracture	Appearance of fracture
	20384	980	11	100,800	Fracture sound
T.C. 3.25%					
G.C. 2.397					
C.C. 0.853		980	5	10,000	Fracture sound
Si. 1.328	20384	980	6	9,200	Slightly open
S. 0.95					
P. 0.923				19,200	Grained
Mn. 0.290					
T.C. 3.192		980	5	10,000	Trace Unsound
G.C. 2.289		980	6	10,000	
		980	7	10,000	
C.C. 0.903		980	8	10,000	
		980	9	10,000	
Si. 1.314	40992	980	10	10,000	
		980	11	10,000	
S. 0.101		980	12	10,000	
		980	13	10,000	
P. 0.909		980	14	10,000	
		980	15	800	
Mn. 0.335				100,800	Very Fine Grain

ing a similar silicon content, but with lower phosphorus and sulphur after undergoing the refining action of an electric furnace.

Table 1 gives particulars of the transverse results brought up to an equivalent on the arbitration bar relative to bars cast on the same cylinders as those selected for tensile example.

Although the two previous tests are not in the strictest sense comparable, there is a mechanical test common to both countries, namely Keep's shrinkage and transverse test. The author was probably the first in Great Britain to have at his disposal a complete set of Keep's machines, and the present opportunity is gladly taken to acknowledge the great value of the shrinkage and transverse test in connection with this class of cast iron.

Could Not Believe Results

A rather lengthy correspondence took place with Mr. Keep relative to the working of the transverse machine with the ½-inch shrinkage bars. Mr. Keep expressed the opinion that the alignment of the machine had become affected during its transit. He arrived at his conclusion from the high results shown on the diagrams forwarded to him. In regard to these he said, "Probably we should not have a ½-inch square bar to break at over 425 pounds." Nothing could be found wrong with the machine and as the result appeared to be borne out by other mechanical tests taken on bars of varying sizes from the same metal a few ½-inch bars were sent to Mr. Keep with a diagram of the corresponding bar in each set. The breaking loads varied from 590 to over 700 pounds. Mr. Keep replied as follows: "I did consider the high results obtained as due to your machine being out of order, but I was mistaken as my machine gives the same results. The iron is remarkably strong I don't know of anything as good."

In Great Britain we consider Mr. Keep knew all about the mechanical tests that American irons will stand. The results shown in Table II of tests made with the same class of iron as those dealt with in Table I are not only typical of results obtained by the author but of those secured by other workers.

The general practice differs somewhat between the two countries in regard to the allowable percentage of the chemical elements in different classes of gray cast iron. This is undoubtedly due to prevailing differences in the irons and not to a lack of metallurgical knowledge.

Briefly stated, some of the principal differences are as follows:

With one or two notable exceptions, practical foundrymen in America appear to pay little attention to total carbon. While carbon receives special attention and is frequently mentioned, it is only lately that total carbon has had due consideration. The quantity of combined carbon is important, but it is obvious that with varying amounts of total carbon the same percentage of combined carbon will have a different effect. Dr. Stead* has shown examples in which increases of 0.1 per cent of praphite have reduced transverse strength by 224 pounds and tensile strength by 1792 pounds per square inch.

Silicon receives a great amount of attention in American foundry practice and in conjunction with sulphur appears to be regarded as the Alpha and Omega by the purchasers of pig irons. One hears a great deal of "silicon control." In Great Britain silicon is merely considered with all the other elements entering into a commercial analysis. It must not be supposed that there is any lack of appreciation of the value of silicon, since in Birmingham—the home of Professor Turner—it is probable that more research work has been done with regard to the influence of silicon than in any other center. A formula which the author has used for many years with marked success in connection with the ratio of silicon to carbon in gray cast iron mixtures is as follows:

$$X = \frac{C}{4.26 - \frac{Si}{3.6}}$$

where X = the ratio of silicon to total carbon
C = total carbon present.
Si = Silicon present.

$X = 0.9$ to 1 for such work as pipes, grates, easily machined castings and general ordinary work.
$X = 0.83$ for locomotive cylinders and castings requiring *maximum transverse strength.*
$X = 0.76$ to 0.82 for steam, gas, oil and diesel engine cylinders, and castings requiring *maximum tensile strength.*
$X = 0.75$ to 0.8 for chilled castings.
$Y = 0.85$ for acid resisting castings.

High Sulphur

At one time in this country sulphur was considered the arch enemy of the ironfounder, although probably it is not taken quite so seriously as it is in America. In his exchange paper George K. Elliott considers that sulphur above 0.07 per cent is dangerous. This does not agree with the results of Coe's* research on British irons. Coe found that sulphur within the limits of his work did not increase the brittleness of cast iron but appears to increase resistance to fracture.

In Table I the sulphur appears in a proportion twice the amount which Mr. Elliott considered dangerous, yet it does not appear to have prevented a high degree of strength being obtained. A liberal proportion, up to 0.12 per cent, has in the author's experience been found to have a beneficial effect upon the wearing properties of cylinders and liners subjected to heat conditions while no difficulty has been met within the way of blow holes provided the metal has been melted and cast hot.

To an appreciable extent phosphorus is considered in America to be detrimental to the strength of gray cast iron. George K. Elliott in his paper states "Irons of greatest strength contain only a small amount of phosphorus." Dr. Moldenke in Principles of Iron Founding appears to put the limit for strong castings free from strains

*British Foundrymen's association, 1915.

*British Foundrymen's association, *Proceedings*, 1911-12.

at 0.4 per cent. The author's experience points to the conclusion that with the strongest British iron the distribution of the *phosphorus*, provided the amount does not exceed 1 per cent, is more important that the actual quantity present. Phorphorus in a segregated form, the usual form in all weak irons, is dangerous where strengths are required, but provided it appears in the network or cellular form no detriment to strength is experienced with phosphorus up to 1 per cent. This form is assisted so long as the silicon and total carbon are restricted in the ratio appearing in the formulas for strong irons.

Manganese Held To Be Detrimental

Agreement appears to be more general in regard to the benefit to be derived from the poling action of manganese, but the author believes that manganese to the extent of 1 per cent or over is detrimental to good wearing properties under heat conditions. This element has a way of developing spiky crystals which break off under rubbing and prevent the formation of that highly polished surface generally regarded as the distinguishing characteristic of all good wearing cast iron. Apparently, there is much to be gained by keeping this element restricted to the proper proportion called for by the amount of sulphur present and for this purpose manganese should not exceed five times the amount of sulphur; beyond this proportion there, is a danger of the formation of manganese carbide.

Although chemical analysis necessarily forms the basis of all scientific work in regard to cast iron, it does not follow that similar analyses necessarily involve similar physical properties. It is adso admitted that strong gray irons are associated with the matrix consisting of fairly large areas of well defined laminated pearlite, relatively stiff portions of cementite and small graphite, and these formations are illustrated by typical examples in Figs. 1 and 2.

While the miscroscope is a useful adjunct to chemical analysis the utility of the miscrograph is limited; it being impossible to determine therefrom relative physical properties of specimens with mathematical precision, or to ascertain within narrow limits the relative variations. In all probability this is due to our imperfect knowledge of both subjects and it may be hoped that further research will clear up some of these matters.

Occasionally, it is quite impossible in dealing with this class of iron to discover either by chemical analysis or the usual methods of miscroscopic examination great differences in physical properties. An interesting example of this took place some time ago. It was found that the highest tensile test obtained in 60 consecutive days' workings was lower than the lowest tensile test during the next 60 days. The metal was of similar chemical analysis but the mixture had been varied by introducing a different pig iron brand as one of the three constituting the charge.

A research was carried on by the late George Hailstone and the author* in connection with this class of investigation. All the methods usually employed for detecting the cause of difference in physical properties such as chemical analysis, high and low power miscroscopic analysis and the employment of various etching agents failed to show any reasonable cause for the great difference which existed

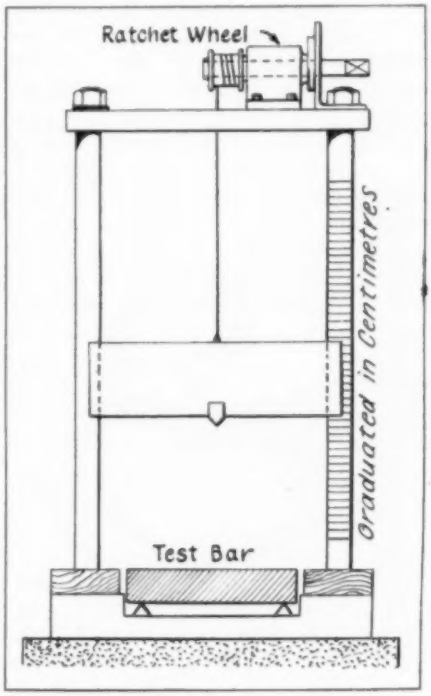


FIG. 7—MACHINE USED IN MAKING THE SHOCK TEST

As a further test, specimens were deeply etched with 20 per cent nitric acid in water as suggested by Stead and afterward re-examined under low magnification. It was then found that the strength of the material was directly related to the particular formation of the cementite and phosphide eutectic. The stronger the iron, the clearer were these two microscopic elements in the network formation as will be seen from Figs. 3, 4 and 5.

The author has made many hundreds of examinations in order to test this and has never found a single example to the contrary. The net work formation is apparent at about 26,880 pounds tensile strength and becomes more pronounced as the strength increases. In the author's view this method gives a surer approximation of the physical properties of the metal than any other form of metallography and is often superior to chemical analysis. It must be remembered, however, that the field under observation must be typical of the whole. In the illustrations given the micrographs are taken from the center of the bar.

In connection with the research already referred to the authors as one of their conclusions decided that the temperature at which the pig iron is made in the blast furnace has a direct effect upon the formation of this network structure. At the time this statement aroused a great amount of criticism, one professor stating that after remelting, the iron had forgotten all about the hole from which it had been dug. Time has since proved the inaccuracy of this view and it is now clear that the temperature of the blast furnace has a marked effect upon the physical properties of the metal, and that these are maintained after remelting.

One progressive blast furnace manager has found that pig iron having this network structure, after going through the puddling furnace, yields wrought iron with higher physical properties than is to be obtained from a pig iron of similar analysis without this structure. He discovered further that with similar working and furnace burden the network structure was controlled by the blast temperature. When using a blast temperature of 900 degrees Fahr. he is always able to get the network structure; whereas if the temperature is increased the network diminishes until at 1100 degrees it disappears entirely with a corresponding lowering of physical properties of the wrought iron, the general chemical composition of the metal being the same. As the result of these discoveries the blast furnace manager has now fitted his furnace with pyrometers for recording the temperature of the blast and is able thereby to obtain more regularly consistent results.

Network Structure Increases Strength

Another criticism by a well known metallurgist was that although greater tensile strengths were associated with a net work formation of the cementite and phosphide eutectic he thought the metal would give less resistance to shock or fatigue.

Rotary fatigue tests were taken by the Wheeler method by the Sheffield testing works on the bars whose struc-

*British Foundrymen's association, *Proceedings*, 1908-09.

ture is shown in Fig. 3 and 4 and these are given in Table III. Fig. 6 gives a general description of the method of applying the test and the dimensions of the test bar. The comparative results are even wider apart than appears from the tensile results.

The fundamental law govening the phenomena of the formation of the network structure has not so far been definitely and satisfactorily proved. J. E. Fletcher, however, has furnished an explanation which has the greatest degree of probability. Mr. Fletcher is advising director to the British Cast Iron and Wrought Iron associations and has devoted much thought and research to the elucidation of this problem in connection both with the blast furnace and the cupola. His explanation is as follows:

He believes that this structure follows the original boundaries between the crystals of the metal which is first fused during the descent of the iron to the fusion zone in the blast furnace. The carbonization of the crystals follows their boundaries as decarbonization follows them in the mechanism of the malleablizing process.

If the blast penetration effect while passing the tuyere zones is drastically oxidizing, following rapid carbonization in hot blast furnaces, then the strong boundary intercohesion is more or less destroyed, with possible gas and oxide inclusions along the boundary films.

With the soft blast of cool or cold blast furnaces this action is absent, and the intercohesional strength of the crystalline structure, due to the presence of combined carbon and air—unimpaired by gaseous and iron oxides and minute slag inclusions—is maintained.

Shocks Test Popular

Points which the author has found helpful in producing regular results with this class of iron have been close attention to chemical analysis and regular testing for general hardness by the drill method. But it should be remembered that with these strong irons a much stiffer machine is required than that known as the Keep's machine. Owing to its lack of rigidity the author's experience with this machine has been disappointing.

Regularity of hardness, which is a governing factor of high physical properties, is only attainable by strict attention to blast pressure, and in this connection a recording blast pressure gage attached to the cupola is most desirable.

A test becoming general in Europe for cast irons of the highest physical properties, more particularly in connection with casting for diesel and large gas engine piston and cylinder liners is the shock test. This is carried out by testing a bar cast 40 millimeters square supported on knife edges 160 millimeters apart by dropping onto it a weight of 12 kilograms from varying heights. Attached to the weight in such a way as to strike the bar in the center parallel to the supporting knife edges is fixed another knife edge. The face of all the knife edges are rounded to a 1/16-inch radius. So far as the author is aware this test is not in use in America. A general arrangement of such a machine is shown in Fig. 7.

In carrying out a shock test we commence with a drop of the weight from a height of 30 centimeters increasing the height of the drop by increments of 5 centimeters until the sample breaks, the height at which the bar eventually breaks being taken as the test figure. A result of 55 centimeters is considered none too high for the class of work named although it is quite a severe test. The maximum attained by the author has been 88 centimeters.

Mr. Wheeler uses the same sized bar and machine as a fatigue test, but for this commences with a drop of 28 centimeters and increases by heights of 1 centimeter. The number of blows required to fracture the sample should be taken as the fatigue test numeral.

A bar from the same metal as the tensile bar of Mr. Wheeler's referred to in the early part of the paper withstood 30 blows, having a range from 28 to 57 centimeters.

In conclusion if, as has been suggested in the first part of this paper, there is a wide difference in the strength of the respective gray cast irons, of which some particulars in regard to the British have been given, the author would suggest the query whether this may not be due to the slow running furnaces in Great Britain producing metal having better properties than that made by the large fast running furnaces which appear to be general in America. Unfortunately, even in Great Britain the slow running furnaces are diminishing in number.

The author's best thanks are due and are hereby tendered to Professor Turner for help with some of the micrographs and to Messrs. Bellis and Morcom for their permission to publish some of the results.

Revise Safety Code for Abrasive Wheels

A revised safety code for the use, care and protection of abrasive wheels has been approved and published by the American Engineering Standards committee. The work of revising the code was begun two years ago when on April 3, 1920, the American Engineering Standards committee invited the International Association of Industrial Accident boards and commissions and the Grinding Wheel Manufacturers' Association of the United States and Canada to act as joint sponsors for the code in question.

A committee of 30 members was chosen and meetings were held. As a result a code was drafted which was submitted first to the grinding wheel manufacturers for approval. A few changes were suggested and a revised code was resubmitted to the sectional committee and to the International Association of Industrial Accident boards and commissions. The accepted code was approved by the foregoing bodies together with the Grinding Wheel Manufacturers, Association of the United States and Canada, and the American Engineering Standards committee.

The code is divided into 11 sections as follows: 1—scope and definitions; 2—types of protection devices; 3—handling and storage; 4—general machine requirements; 5—protection hoods; 6—work rests; 7—protection for cup, cylinder and sectional ring wheels; 8—flanges; 9—mounting; 10—speed; 11—operating rules and general data.

The code is well written in nontechnical language as far as possible so as to furnish the abrasive engineer, the safety engineer and the plant operator with all the necessary information for installing and operating grinding wheels with safety. Copies of the code can be obtained from practically any grinding wheel manufacturer, or from the American Engineering Standards committee, 29 West Thirty-ninth street, New York.

An investigation of the commercial methods of manufacture, together with the properties and uses of light aluminum-alloy systems, e. g., aluminum-by the United States bureau of mines for the purpose of making available a compendium of the existing information. The compiled data are to be published in the form of a bureau of mines bulletin. The report covers the commercial production of aluminum-alloy sand castings, die castings, and permanent mold castings, and worked manufactures; foundry practice; the properties and uses of aluminum alloys; and a discussion of the principal aluminum-alloy systems, e. g., aluminum-copper, aluminum-iron, aluminum-magnesium, aluminum-manganese, and aluminum-zinc systems, as well as the principal ternary systems. Patented alloys are dealt with at some length, and also the preparation of various alloys.

Typewriters Made in Belgium

The Process Was Designed for an Output of 35 to 40 Frames a Day as Compared with Hundreds of Frames Per Day Scheduled in American Foundries Handling Similar Castings

BY JOSEPH LEONARD

TO SECURE a good practical result in the quantity production of typewriter-frame castings various conditions dependent upon the form of the whole piece must be taken into consideration. These conditions are governed by the size and relative position of the various bosses and sockets, by the necessity of producing a casting which may be machined readily, and by the further necessity of keeping the cost of production as low as possible.

The purpose of this paper is to present a few notes describing the method of molding and casting typewriter frames in a prominent Belgian foundry. Although the number of castings made is relatively large, the orders probably are not of a size which in the United States would be considered as placing the work on a quantity production basis. The maximum output provided for is 35 to 40 frames per day. This was considered insufficient for the installation of highly specialized equipment such as is found in American plants. Instead a comparatively simple rigging was designed to carry out the work.

The molds are made in a two-part aluminum flask, the drag sufficiently deep to take the whole casting, the cope nothing more than a flat cover containing the branch gates. The casting is poured base upward, that is, the top of the typewriter frame on which the carriage runs is at the bottom of the mold.

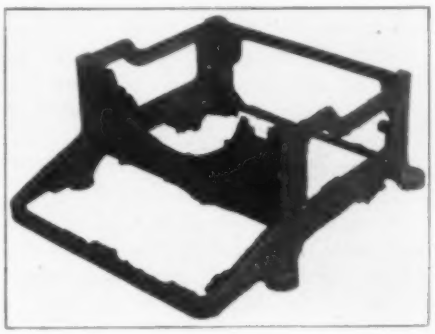
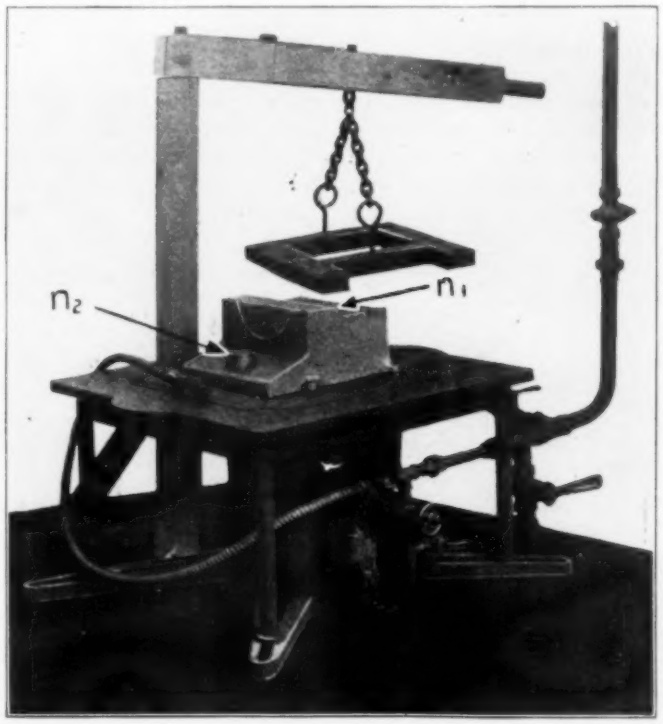


FIG. 3—A CASTING IN THE ROUGH

The inside surfaces of the frame are formed by a large body core, which has the same general shape as the casting and practically fills the mold. This core, which determines the metal section of only about 3-millimeters, or about ⅛-inch, must be accurately centered. To accomplish this two machined iron guide-pin sockets, d_1 and d_2, Fig. 4 are cast in the flask. Pins as shown in Fig. 5 are fitted into these sockets or bushings. These pins engage similar bushings set in the core which is thus accurately centered without relying on the judgment of the workman. The mold is dried. Two sands are used in making the core as will be explained subsequently.

The pattern is in a single piece, and is of metal for the purpose of ensuring strength and accuracy. It is molded on a plain jar-ramming machine of a type manufactured in England. The flasks used are of aluminum, and the details of the pin and socket arrangement re-

From a paper presented before the convention of the American Foundrymen's association, held at Rochester, N. Y., June 5-9, 1922. The author, whose address is given as Herstal, near Liege, Belgium, is president of the Belgian Foundrymen's association.



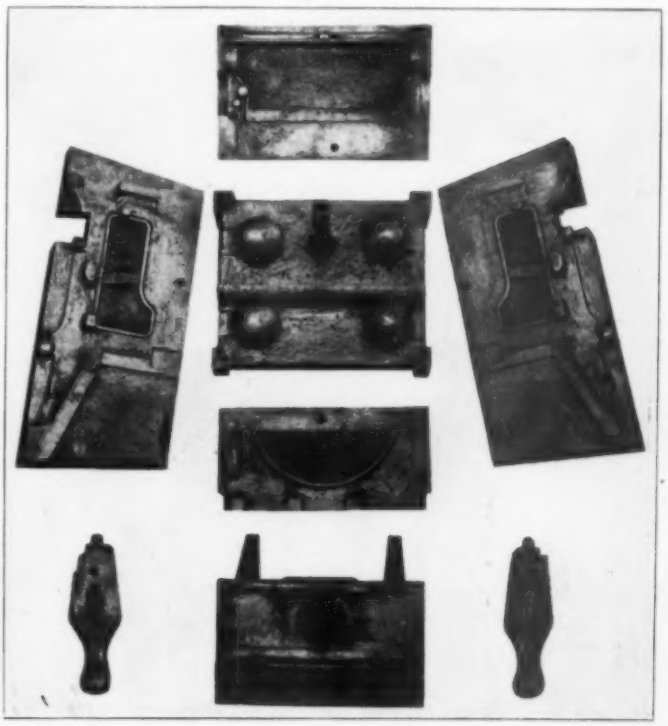
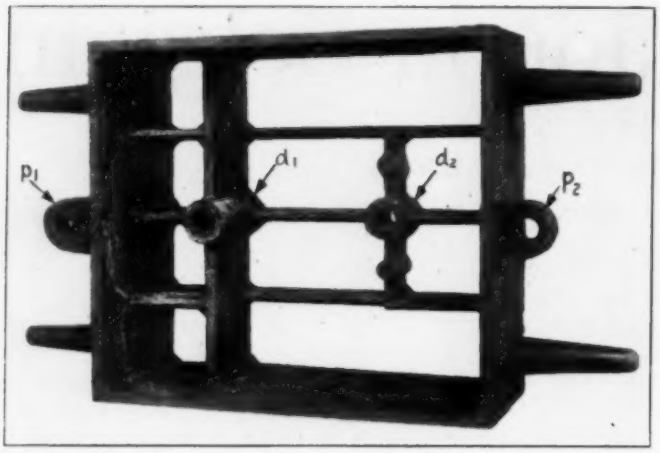


FIG. 1—A SUITABLE SHAPED WEIGHT WAS ALLOWED TO REST ON THE UPPER SAND IN THE DRAG TO SUPPLEMENT THE JARRING ACTION OF THE MACHINE FIG. 2—THE COREBOX IS MADE UP OF A NUMBER OF DETACHABLE ALUMINUM PLATES



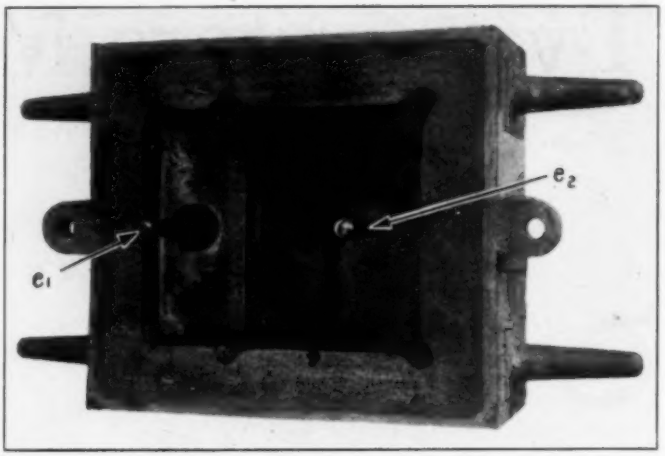


FIG. 4—THE DRAG IS PROVIDED WITH BARS, LUGS ON THE ENDS FOR LOCATING THE COPE AND ALSO FOR LOCATING THE DRAG ON THE PATTERN PLATE PINS SET IN THE SOCKETS IN THE CENTER HELP TO CENTER THE BODY CORE FIG. 5—A DRAG WITH THE CORE CENTERING PINS IN PLACE

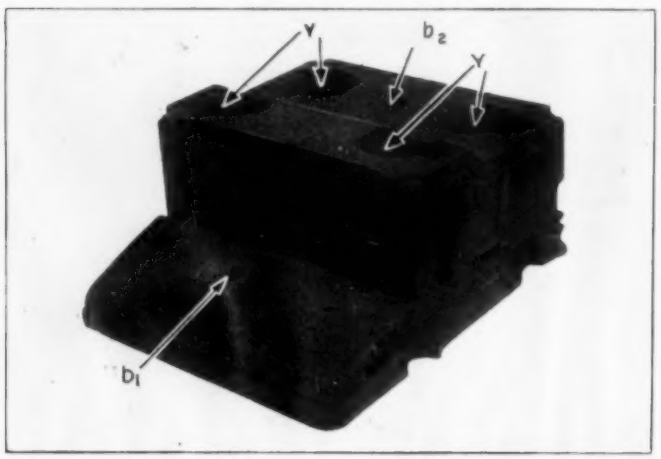
ferred to are as follows: Two ears, p_1 and p_2, Fig. 4, are attached to the flask, and two internal sockets d_1 and d_2, are joined to the flask by ribs. This combination serves to strengthen the flask. The sockets d_1 and d_2 are milled on the ends and rest accurately on the upper portion of the pattern n_1 and on the boss n_2, Fig. 1. It is clear that these two surfaces always are equally distant from the part of the flask forming the joint, which is planed smooth.

The bore of the two sockets in the drag is 22 millimeters, or about 55/64-inch in diameter and they are accurately centered in relation to the lugs, P_1 and P_2, Fig. 4. The position of the two pins F_1 and F_2, Fig. 8, in the corebox, correspond precisely with the position of the sockets D_1 and D_2 in the drag, Fig. 4. While making the core, the operator places iron bushings B_1 and B_2, Fig. 6, over these pins in the corebox. When the time comes to assemble the mold, two pins, E_1 *and* E_2, Fig. 5, are placed in the sockets in the drag, the core with the bushings B_1 and B_2 in position, is slipped over the pins in the drag, thus setting the core with the utmost precision and preventing any injury to either the core or the walls of the mold. After the core is located the pins e_1 and e_2 are withdrawn and the drag is covered with a cope in which the gates have been formed on a plate designed for the purpose.

Our acquaintance with jar machines is quite recent. We were under the impression that the jar ramming process was sufficiently uniform to enable the machine to produce a practically perfect mold. However, the result in this particular instance did not measure up to anticipation. The upper part of the mold was not really rammed. The corresponding portion of the casting was swollen and an excessive amount of excrescences had to be removed in the cleaning room. We afterward placed the heavy cast iron frame shown in Fig. 1 on top of the sand in the drag during the ramming operation, and this practically eliminated the inequality in the density of the sand in the drag.

I do not know whether or not there is any other remedy, but if not I consider that this defect which must recur, and which has been repeated in our work with all pieces having sharp corners, indicates a weak point in this method of ramming sand. This defect easily may be corrected on long runs of duplicate castings, by providing a suitable shaped weight as outlined, but the remedy is not practical where patterns are changed frequently. This ramming defect has been observed not only by ourselves; among others, a large English foundry has experienced the same difficulty, and the jar machine only is used for the first ramming. The sand in the upper part of the flask is rammed by hand. I mention this circumstance to our American friends who use jar machines regularly, and trust that I am not indiscreet in hoping to have their opinion on the subject of ramming molds in general.

Discussion between the advocates of the jar machine and the plate molding machine is frequent in Europe. I would point out that, according to several trials made on flasks without crossbars, the ramming of the frame dealt



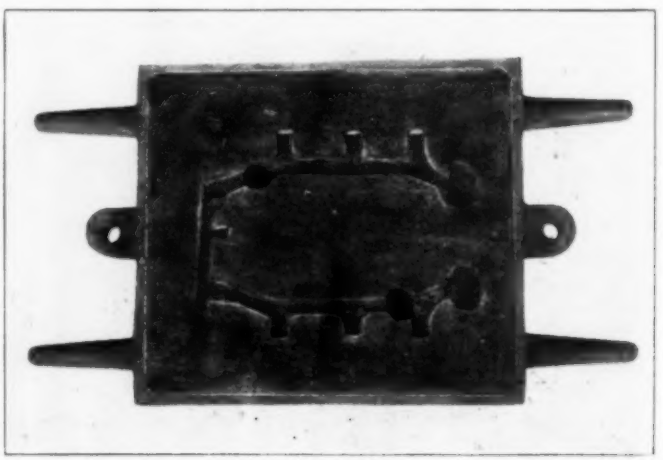


FIG. 6—A CORE AS IT APPEARS ON THE DRYING PLATE AND IN THE OPPOSITE POSITION FROM THAT WHICH IT OCCUPIES IN THE MOLD FIG. 7—THE COPE SIMPLY IS A FLAT COVER CONTAINING THE RUNNERS AND GATES THE CASTING IS POURED FROM TWO LADLES

with in this paper is effected perfectly on a plate ramming machine. The fact that there are sockets and ribs in the flask is a difficulty in the use of these machines, but probably it may be obviated. I continue nevertheless to employ the jar ramming method, as the machine is installed and equipped with accessories and the results are good in practice; but if the manufacture of such castings had to be repeated I should consider the advisability of equipping a pressure machine for making the mold, and this with nine chances in ten of a successful result.

The molding sand obviously must be prepared with special care to obtain a fine sand and consequently a sufficiently smooth molding surface. The apparatus for sand preparation is simple, comprising a crushing mill and a separator. The sand on coming from the separator is passed through riddles with a 5-millimeter mesh, 1/5-inch, to complete the action of the separator. The preparation is done by the dry process.

The corebox is of special construction. The shape of the core itself necessitated the form of corebox shown in the accompanying illustrations Figs. 2 and 8. The various plates, made of aluminum on account of its strength and lightness, are released laterally for the withdrawal of the core and are assembled inside a wooden frame for making the core. The exterior of the core is made of silica sand bonded with linseed oil, together with a little dry binder. The layer of what corresponds to facing sand in the core is about 1 centimeter, a little over ¼-inch in thickness. The interior of the core is filled with ordinary molding sand, partly on the basis of economy, but principally to facilitate contraction of the casting. If the entire core was made of white sand the resistance to contraction would be great enough to rupture the casting. However, it is not necessary to use an all dry sand core mixture. Cores made after the manner described are sufficiently hard to stand a considerable amount of handling. They are not blacked. The coremaker rams the white sand sufficiently dense to obtain a smooth core surface and a fine internal finish on the casting.

Not only must the pouring be done quickly, but the metal must not have too long a distance to travel in filling the mold, otherwise it would cool too quickly, the mold would not fill completely and the metal might become too hard. We use two ladles for pouring and the metal enters the mold cavity through a number of shallow gates formed in the cope as shown in Fig. 7. On account of pouring the mold from the top edge, the metal on reaching the bottom cooled too quickly

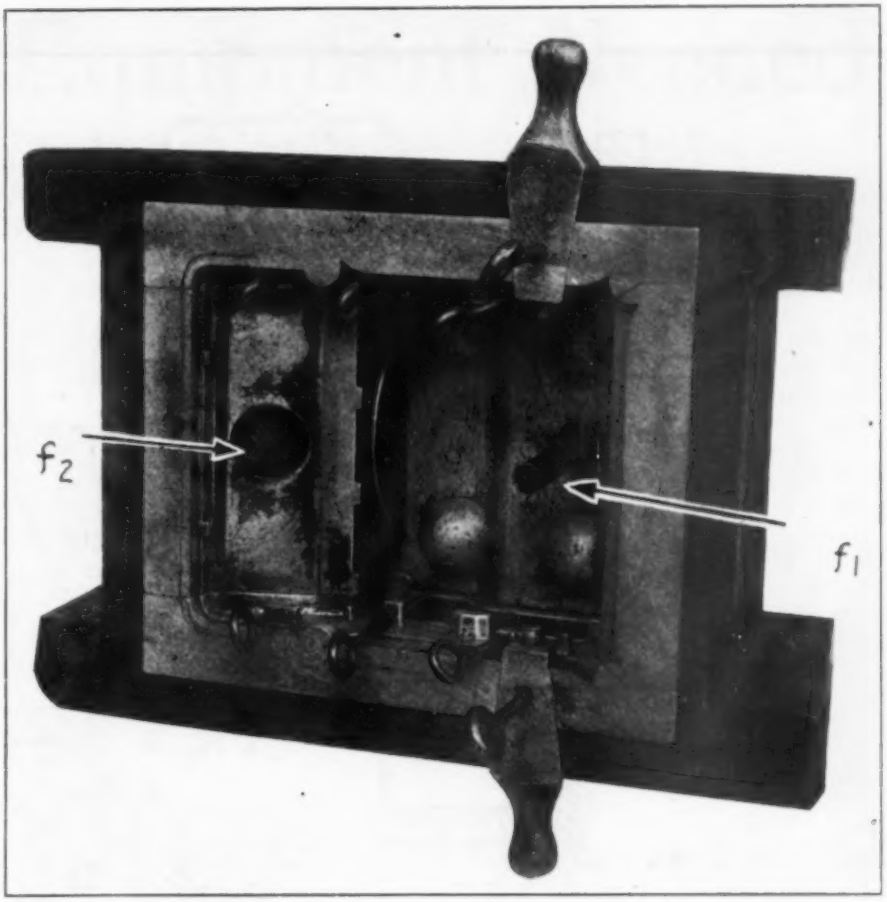


FIG. 8.—THE PLATES FORMING THE COREBOX ARE HELD TOGETHER IN A WOODEN FRAME. AFTER THE CORE IS MADE AND ROLLED OVER ON THE PLATE THE FRAME IS LIFTED OFF AND THE PLATES REMOVED LATERALLY

and became too hard to work under either machine or file. We remedied this condition by providing large cavities in the bottom of the core as shown at *y*, Fig. 6. These cavities are connected by shallow gates to the lower edge of the frame and the result is that the first iron, instead of resting in the bottom edge of the frame, flows into the cavities in the core. In this manner a certain amount of circulation of hot metal takes place which heats the mold and helps the metal in the lower part of the frame to cool more slowly.

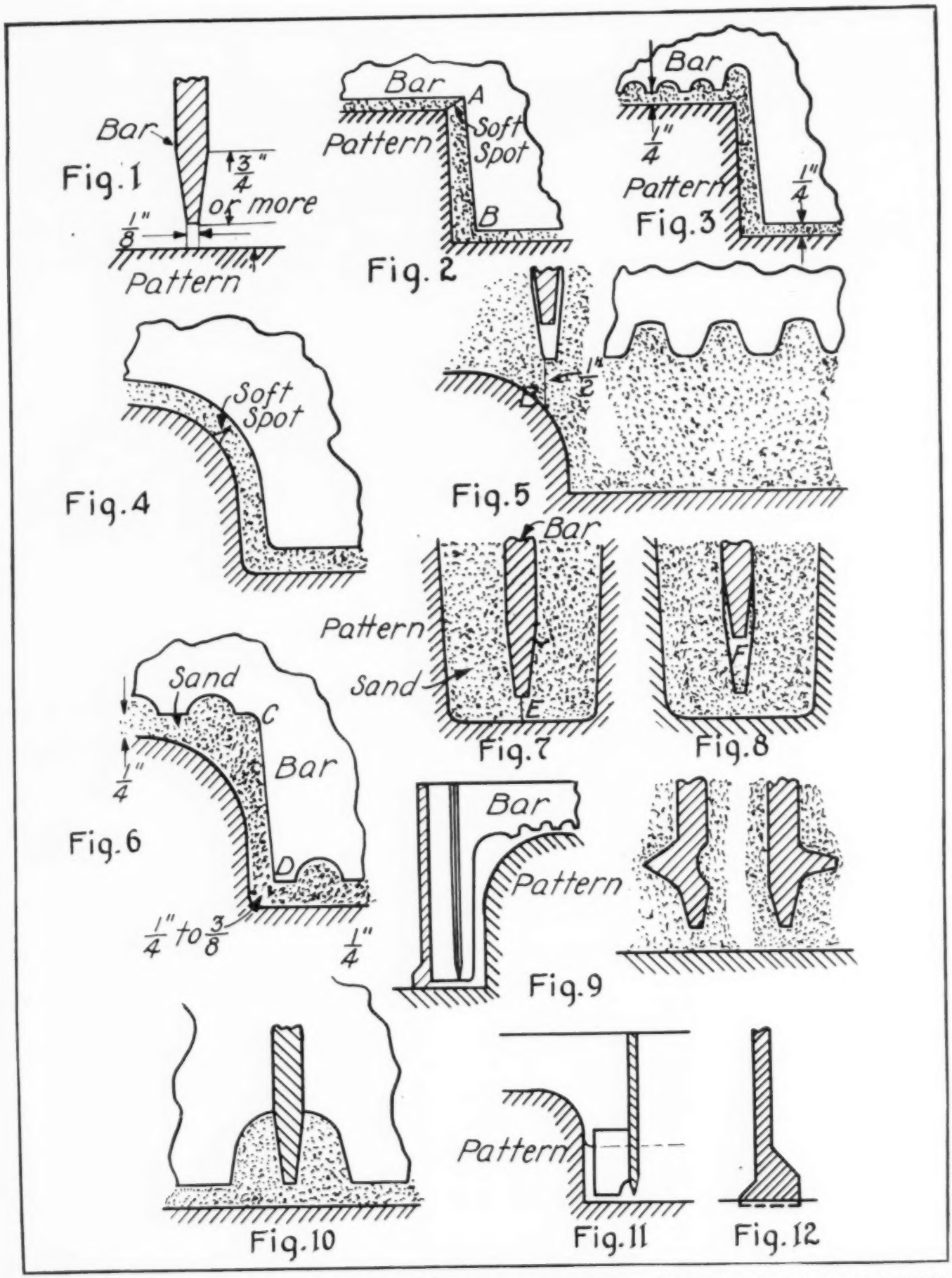
Up to the present our iron analysis has been: Silicon 3.25 per cent; manganese 1.12 per cent; phosphorus 0.14 per cent; sulphur 0.09 per cent; total carbon 3.55 per cent; graphite carbon 3.06 per cent. However, to render the castings more machineable we are considering the advisability of reducing the manganese to 0.4 or 0.5 per cent.

Book Review

Burning Liquid Fuel, by William Newton Best; 341 pages, 6 x 9 inches; cloth; published by the U. P. C. Book Co., Inc., and for sale by THE FOUNDRY, Cleveland; price, $5 net.

When a pioneer in the development of a fuel has the fortunate experience of witnessing the expanding use of that fuel until it becomes one of the world's most important commodities and also keeps in touch with each step in the advance in methods affecting the fuel, that person obviously is placed in a most advantageous position to speak with authority on the subject which has claimed his attention.

Starting with a chapter on early experiences in adapting petroleum to industrial uses, the author devotes a chapter to the origin, production and analysis of the fuel. This is followed by a brief discussion of atomization, one on various oil systems, and another on refractory material used in oil-fired furnaces. The succeeding chapters are devoted to detailed descriptions of applications of oil burning systems to various industrial operations, including firing of locomotive, stationary and marine boilers, steel foundry melting, heat treating, malleable, gray iron and brass foundry melting equipment, forge work, enameling, etc. The final chapter is a brief treatise on combustion engineering. The text is amplified by 315 illustrations, many of which are reproductions of drawings of actual furnace installations.



FIGS. 1 TO 12—TYPICAL METHODS OF ADJUSTING BARS TO FACILITATE THE USE OF FLASKS ON JOLT RAMMING MOLDING MACHINES

Adequate Equipment Needed

Cope and Drag Must Be True, the Walls Must Be Sufficiently Thick So That the Parts Will Be Rigid, and the Pins, Pinholes, Trunnions, etc., Must Be Accurately Placed

BY ARNOLD LENZ

FLASK equipment often receives only passing consideration, and it is not uncommon to see a new flask of an antiquated design used in connection with a molding machine and patterns of the latest model. To operate a modern molding machine at its highest efficiency the flask equipment must be equally modern. Many good molding machines have been condemned because of poor equipment.

The greatest efficiency is possible when the operations are reduced to filling the flask with sand, jolting, squeezing, stripping or rolling and drawing the pattern. The setting of gaggers, which requires some skill and tends to slow up the operations considerably, should be eliminated, and it is possible to do so on the majority of jobs. How far this can be carried in production work is shown by the castings in Fig. 19, which are made in a foundry that has discontinued the use of gaggers entirely. The advantage of this must be apparent to every practical foundryman; it leaves the sand heaps free from a lot of interfering material and reduces the ramming to a few simple operations which any intelligent laborer can learn and perform at high speed within two or three days.

The castings are produced in a continuous foundry where the flasks are rammed before they have completely cooled off. Only in exceptional cases is wetting or clay washing of copes resorted to, and then only at certain points. The thin section in these castings does not permit the use of heavy bonded sands and contrary to what might commonly be supposed, the sand in use is no stronger than that used in the average foundry.

A great difference of opinion exists as to what constitutes an ideal flask. In a jobbing foundry a cheap wood flask may be most satisfactory for a one-piece job, or it may be a solid or assembled cast iron or steel flask to serve a number of patterns. The snap-flask, solid cast iron, cast aluminum, or pressed steel flasks for small castings are equally good in jobbing and production work. A wood snap-flask gives excellent service on a combination jolt-squeezer, especially if steel bands are used in connection.

The greatest difference centers around the production flask larger than the common snap-flask sizes, used on molding machines. The writer's conception of a good flask for production work is a rigid metal flask designed to allow just enough sand under the pattern in the drag to prevent runouts through the bottom, and swells or other irregularities caused by insufficient sand. The joint of the flask follows the outline of the pattern as closely as practical, yet leaving sufficient space to permit proper ramming and prevent runouts. It has the necessary handles and trunnions for handling, a perfectly machined joint, and interchangeable pins and pinholes. The cope has just enough bars to carry the sand and keep the mold from coping, but not so many as to encumber the ramming and shaking out. The bars are so designed and placed that no tucking and no gaggers and nails are necessary.

The flasks in a production foundry form such an important part of the equipment that they should be laid out by one thoroughly familiar with the available machine and handling equipment, and whose knowledge of how to secure sand in a mold is past the guessing point. As a rule too much of this work is left to the patternmaker, although there are few patternmakers who are familiar enough with molding and the details involved in securing the sand in an intricate cope, to build a good flask pattern. It seems to be hard matter to break away from the old jobbing work cope, in which the bars are nailed, bolted, or cast in, five or six inches apart, irrespective of the contour of the pattern.

The builder of a flask for molding machines also should be acquainted with the peculiarities of jolt-rammed molds. If a cope is rammed by hand the sand will pack tightly against the bars, and in case of wetting or clay-washing the sand will adhere to the bars. This is not true with a jolt-rammed mold. On close investigation a slight clearance will be found between the rammed sand and the

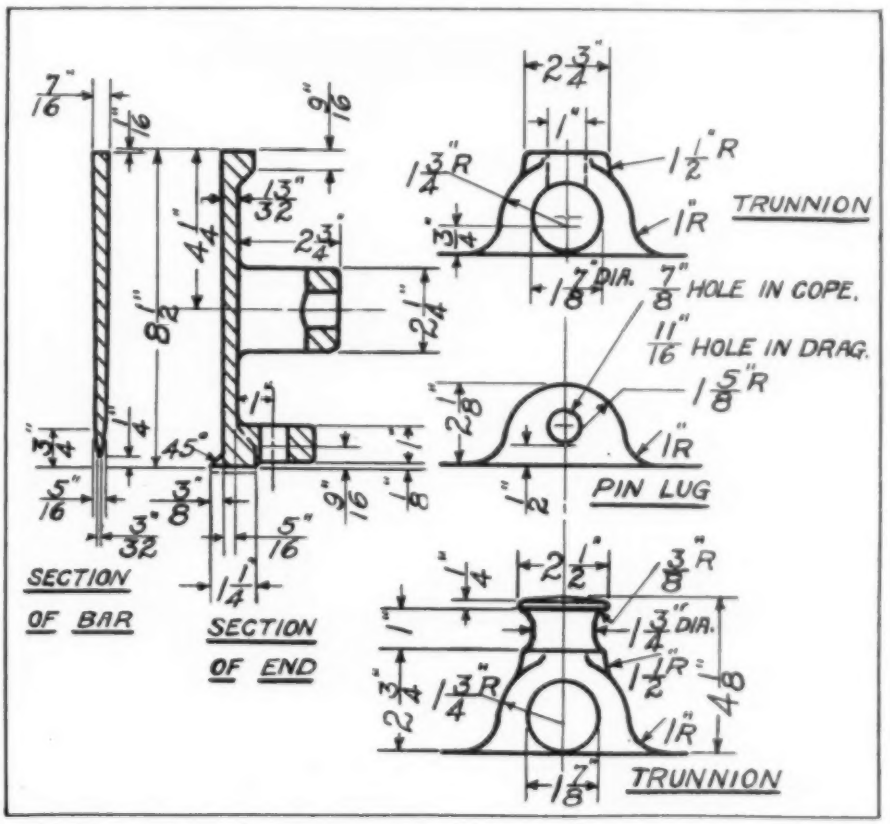


FIG. 13—THIS STYLE OF TRUNNION DOES NOT INTERFERE WITH PINS

From a paper presented before the annual convention of the American Foundrymen's association, held at Rochester, N. Y., June 5-9, 1922. The author is connected with the Saginaw Products Co., Saginaw, Mich.

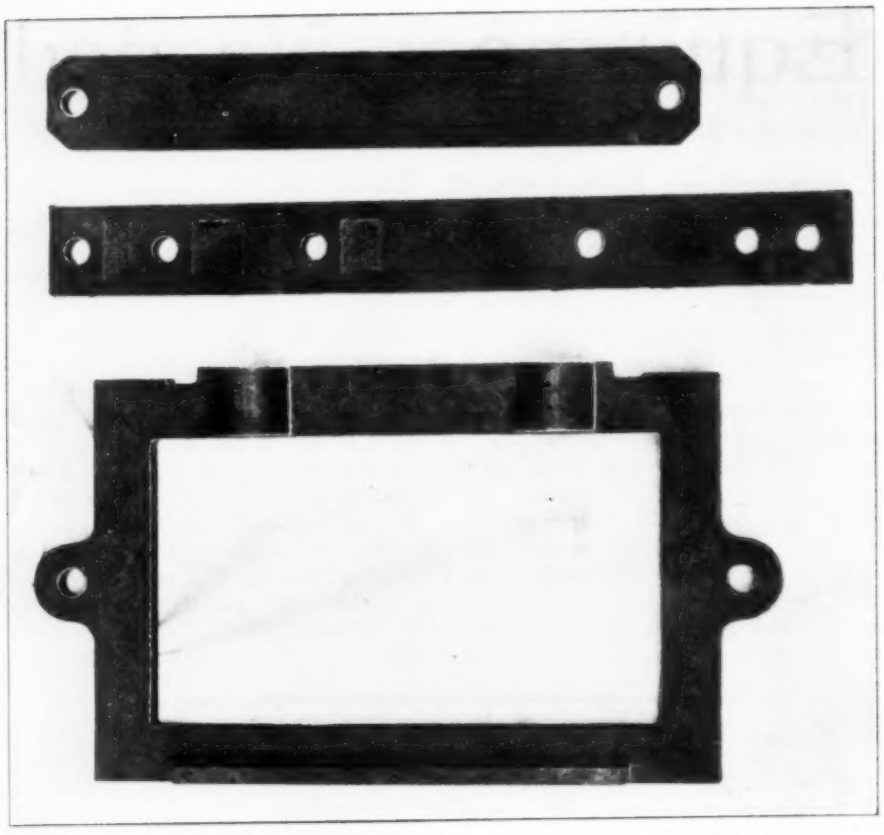


FIG. 14—STYLE OF JIGS USED ON FLASKS AND PATTERN PLATES

bars or sides, due to the vibration set up in the flask by jolting. The squeezing or butting off after jolting will pack the sand against the bars and sides in the upper part of the mold, but unless the cope is quite shallow the pressure will not be sufficient to overcome this condition next to the pattern. This accounts for the many drops on the joint if sand strips are lacking. This vibration partly can be overcome by clamping the flask to the patternplate while jolting. I also have found that by regulating the speed and length of the stroke of the jolt cylinder, according to the weight of the pattern, the vibration can be reduced to a minimum. This is especially true if attention is given to fairly equal distribution of the weight. Where the weight is all on one side of the jolt cylinder the table will develop a rocking motion which always results in a poorly rammed mold.

Steel Flasks

In the past, cast iron has been considered the standard material for production flasks, but recently this has been replaced in many instances by cast steel. This is especially true in continuously operated foundries where a limited number of flasks are used from two to four times a day, and strength is of utmost importance. In the past few years the fabricated steel flask has come more and more into use, and from the point of weight and indestructibility it is quite satisfactory, but unless it is constructed of extra heavy material it sooner or later will develop a warp which, in addition to causing a bad fit at the joint will spring in jolting or squeezing, and cause drops in the cope, also clamping off in the drag half of the mold.

When laying out patterns for cast steel or malleable flasks two important points should be kept in mind: The sections must be heavy enough so they can be poured and the outside walls must be heavy enough to be rigid so they will not bend under the maul of the shake-out crew. If the side walls become dented, no end of trouble is experienced with binding pins on the machines and in closing.

Thickness of Metal

To avoid confusion in describing walls, bars, flanges, trunnions, etc., all dimensions in the accompanying illustrations are based on cast iron, and for castings ranging from 10 to 500 pounds. The walls of a cast iron flask up to 24 x 48 inches may vary from ¼ to 7/16 inch plus draft, depending on the height of the flask, decreasing somewhat in thickness as the height increases. Every flask should have a flange at the joint on both cope and drag and both cope and drag should be machined, or ground at the joints, especially if the flasks are to be used on jolt machines. This will give the flask a good bearing and retard the wear on the pattern plate.

The section of the flask at the joint may vary from ⅞ to 1¼ inches through the flange, according to the size of the flask and the additional strength one

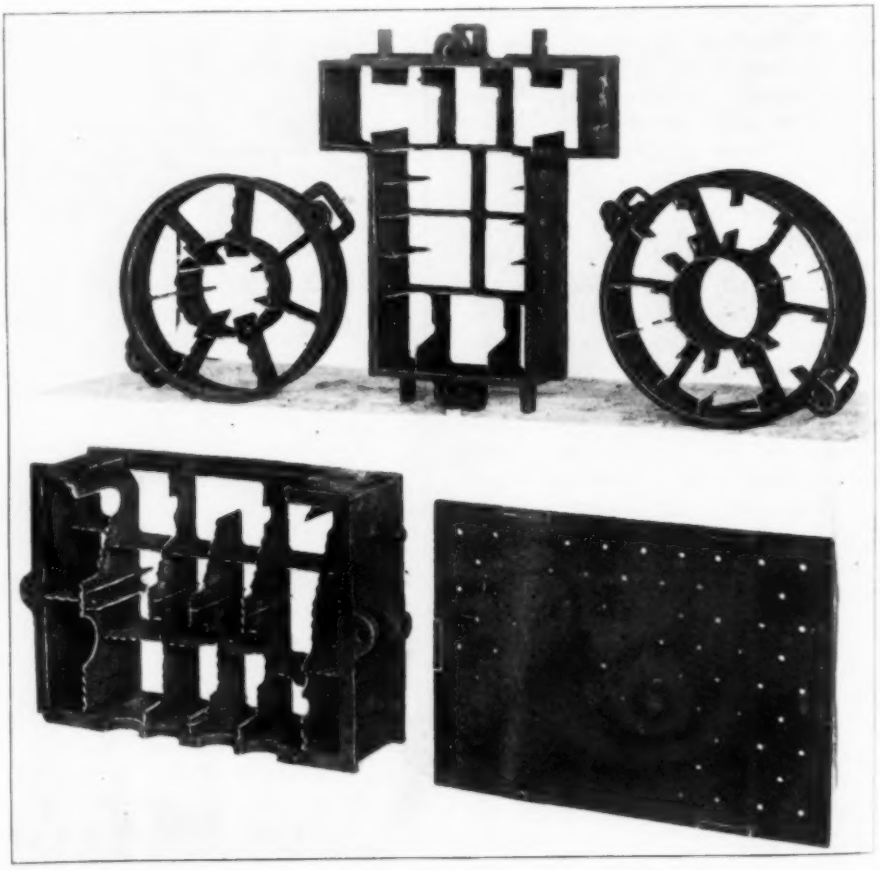


FIG. 16—METAL FLASKS DESIGNED TO CARRY THE SAND WITHOUT THE AID OF GAGGERS BAR CONSTRUCTION PREVENTS SOFT SPOTS

desires to get from a heavier flange. Flanges on top of cope and bottom of drag are not necessary unless desired for additional strength.

Every cope should have a sand strip. Although a sand strip is not necessary in the drag it can be used to give extra width to the joint and in this way assure a better bearing and prevent wear on the pattern plate. The extra labor involved in molding a flask with a sand strip will soon be repaid. While ¼ to ⅜ inch is a good standard width, a sand strip may be made 1 to 1½ inches wide at certain points to make a lift from the joint. A wide sand strip often replaces bars in a bad corner, or nails and gaggers.

After considerable experimenting, the writer has found that it is possible to lay out the bars in a flask so that tucking of bars and setting of gaggers can be eliminated. It is not always possible to eliminate the nails because the projections on the bars may have to be so light that it would be impossible to keep them from breaking off. In this case a cast steel flask has the advantage over one of cast iron. Quite often a nail or spike can be cast into the bar or welded on, but this is not always practical.

Some foundrymen may think it is too much bother to lay out such a flask, but no matter how busy one may be, one half to five hours devoted to laying out a flask is time well spent.

Types of Bars

Although each job may have its own problem it is possible to apply certain rules on every job. For example in Fig. 1 the sand will ram solid under a bar 5/16 inch thick if the bar is tapered down to ⅛ inch next to the pattern and the space between pattern and bar is ¼ inch. While at 3/16 inch the sand will still ram under the bar it is liable to be a little soft, but would be all right over coreprints and on the joint. The taper from ⅛ inch to the thickness of the bar should not be less than ¾ inch to give the sand a chance to grip the bar.

Figs. 2 and 3 show a bar over a sharp corner. To avoid drops at *B* it is necessary to run the bar into the corner as close as possible and also to avoid damaging the pattern by hitting the corner when setting on the flask. About ½ inch has been found close enough to hold the sand and clearance enough to readily release the casting from the flask. A bar following the pattern as in Fig. 2 will produce a soft spot at *A* unless the sand is tucked under the bar. The reason for this is that in jolting the mold the sand will settle considerably from *A* to *B*, but the sand above *A* will not settle down sufficiently to fill in the space left by the settling sand. If this bar is cut out at *A* as in Fig. 3 this soft spot can be prevented. The same condition still exists, but the soft spot will be found up in the extreme corner of *A* and too far away from the pattern to effect the casting. The cut in the bar at *A* may range from ½ inch deep for a low pattern to 1-inch or more for a high one.

A similar condition exists with a pattern as shown in Fig. 4, the bar running parallel with the pattern. Fig. 6 shows the corrected bar. In this case the casting will not bind in shaking out and there is no high corner to be damaged in setting on the flask. The corner *D* therefore can be moved to within ¼ inch to ⅜ inch of the pattern. The bar need not follow the radius of the pattern because the mold forms an arch, the base of which will be sufficiently supported by the corner *D*.

If it can in any way be avoided a bar should never be run across the radius of a rounded part of a pattern in the position shown in Fig. 5, because the distance the bar has to be kept away from the pattern to insure solid ramming without tucking makes it of little use except where the bar is placed to prevent coping. However a bar in this position

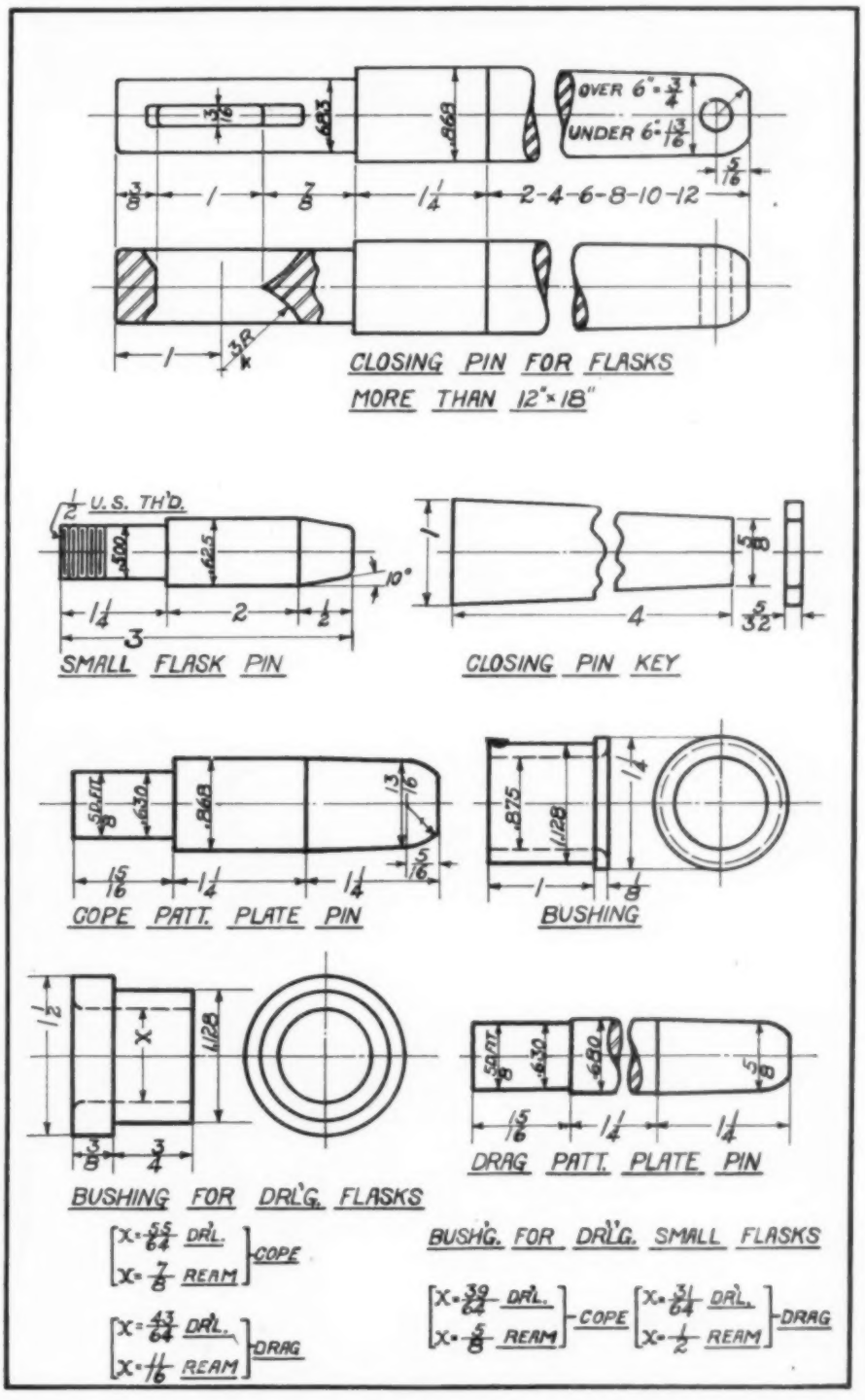


FIG. 15—DETAILS AND DIMENSIONS FOR PATTERN PLATE AND FLASK PINS ALSO CLOSING PINS FOR LARGE MOLDS

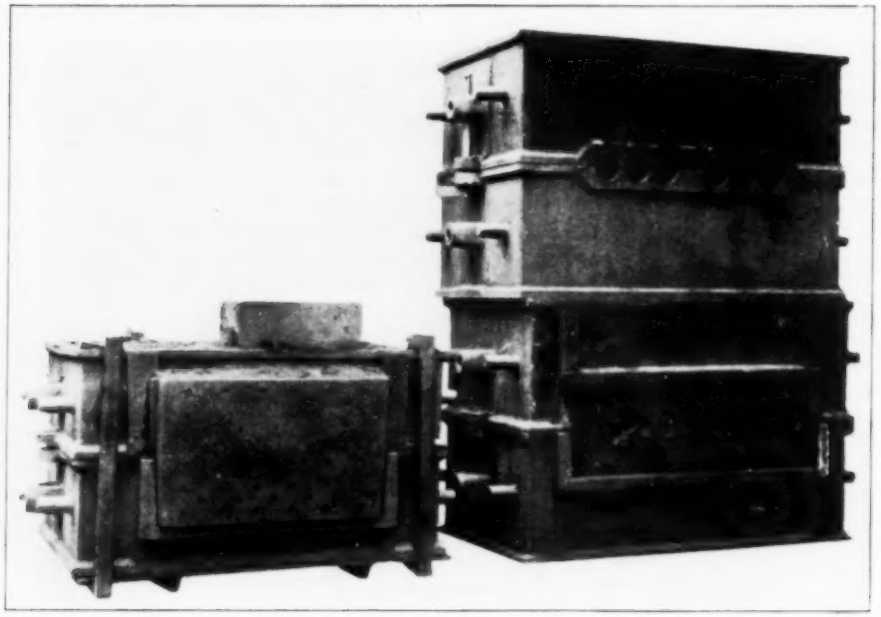


FIG. 17—THE HOLES IN THE SIDE OF THE FLASK ARE COVERED WITH A PLATE AS SHOWN IN THE CLOSED MOLD TO THE LEFT OF THE ILLUSTRATION

can be brought within ½ inch of the pattern if the bars are notched out as in Fig. 5. This permits the sand to feed through from the high to the low part of the pattern.

All bars should be notched the full length wherever possible as this gives the sand a better chance to ram under without reducing the lifting power of the bar. This is best illustrated where a bar is used in a pocket as in Fig. 7. If a solid bar is run within ¼ inch of the pattern the sand is liable to split at *E* and fall away on one or both sides of the bar. This can be largely prevented by notching, as at *F* in Fig. 8, giving the sand an both sides of the bar a chance to bind together at *F*.

Where two bars cross each other as in Fig. 10 one of them should be cut out as shown in the sketch, otherwise there will be a soft spot where the bars join.

Deep Bars Stopped off

In deep copes where there is danger of the sand dropping away from the side in rolling over, three cornered strips may be cast on the side of the bars, as in Fig. 9. Grooves cut into the bar at times may be more convenient and prove just as good. Care should be taken that the strips are not placed so close to the edge of the bar that they create a parting and so defeat their purpose.

At times it is necessary and often not desirable to run a bar or a projecting spur or chuck the full height of the pattern because too many bars interfere with ramming and shaking out and add to the weight of the flask. In such cases the upper part of the bar is cored off as shown in Fig. 11

The sand strip is most effective if it is tapered to a sharp edge next to the pattern plate. To avoid chilling the edge of the sand strip, which would interfere with machining, the casting should be made as in Fig. 12. This will leave a sharp edge after the surplus stock is machined off.

Therefore, it is a great advantage to have all equipment interchangeable. Certain standards should be adopted at the start. Closing pins and pins in the pattern plates should be made standard. This enables one to keep a small stock of pins on hand so that bent and broken ones can be replaced without delay. A flask with the pins in the center is easier to close than one with the pins at one side. On most jobs handled with a hoist, this interferes with the trunnions. Fig. 13 shows a trunnion that will permit the placing of both trunnion and pin directly above each other without interference. One of the trunnions is used in connection with a spring bail or a hinged bail and has proved safer in handling than the other type which is used with a sling. The trunnions and handles are made with cores and are rammed up in the mold. One or two sets of coreboxes will be sufficient for a great variety of flasks.

Equipment Interchangeable

Flasks should be drilled with a drill jig and whenever possible the drill jig should be made before the pattern plate is drilled. A set of hardened drill and ream bushings with a standard outside diameter should be made. By making the holes in the drill jigs, which may consist of plain flat bars to correspond with the outside diameter of the bushings, one set of bushings will be sufficient for a number of drill jigs. Fig. 14 shows three drill jigs, one of which is for several jobs, and also a more elaborate one for a cylinder flask.

The pin lugs on the flask should be of a standard thickness so if a removable closing pin is used and the same is secured by a key a standard size slot will make all pins interchangeable.

Two sizes of closing pins are sufficient, even in a large foundry covering a great variety of castings of medium weight. One size can be used for small

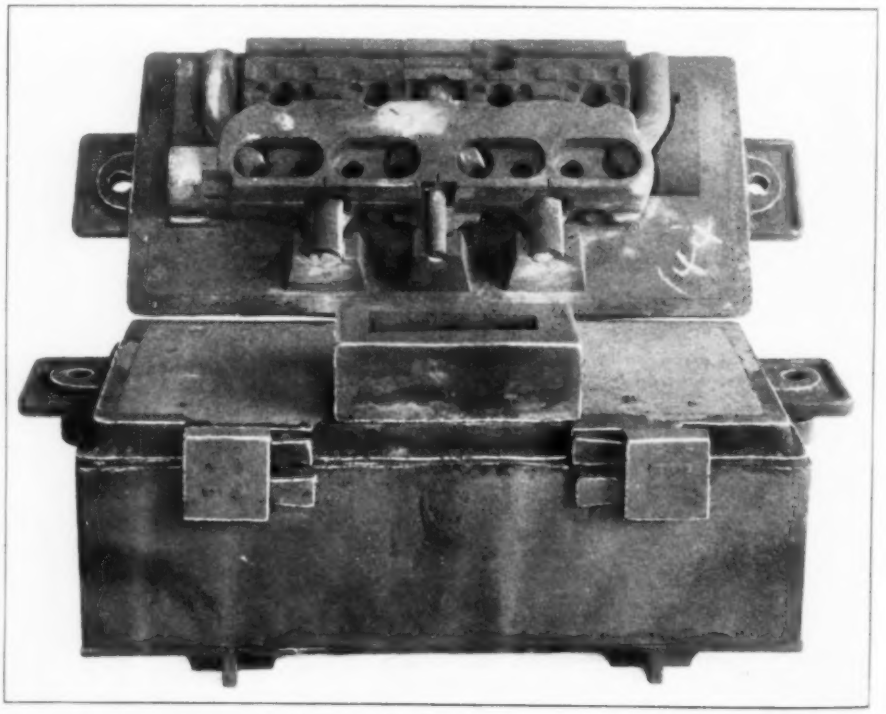


FIG. 18—THE COPE FOR THE CYLINDER HEAD MOLD SERVES FOR A JIG ON WHICH THE CORES ARE ASSEMBLED PREPARATORY TO CLOSING THE MOLD

machine and snap-flasks, and larger size for all flasks over snap-flask size.

Fig. 16 illustrates a set of standard pins for cope and drag pattern plates, for closing the molds, and for light solid bench or snap flasks; also the necessary bushings for drilling and reaming the pattern plates and flasks. It will be noticed that all holes are reamed to size and the clearance is allowed on the pins only varying from 0.004 to 0.006 inch undersize. All pin lugs should be spot faced on the pin side to insure a good bearing against the shoulder.

A ⅞-inch pin with an 11/16-inch shank for large, and a ⅝-inch pin with a ½-inch shank for the bench and squeezer flasks are proving satisfactory. However the sizes are not arbitrary, because any dimensions within reasonable limits will give good results.

Joint Locates Core

Fig. 15 shows typical copes used in the foundry. Of the round flasks, one is cast-steel and the other is fabricated. The one in the lower left is a cylinder flask in which the joints are used for locating the core. These openings are machined to close dimensions. The square or crankcase end, cut in drag, is machined on both sides and bottom, while the cope is machined only on the top edge of the cut for height, the two sides being cast with ¼ inch clearance, depending on the drag for location sideways. The round openings on the cylinder barrel end are bored out accurately in cope and drag. There is no danger of a runout on the barrel end if the cores are up to size as they should be. On account of the large surface on the crank case end it is not practical to depend on the accuracy of the cores, and a backing plate therefore is placed behind the core and the intervening space filled with sand. A cylinder mold with the backing plate in place ready for pouring is shown in Fig. 17.

Fig. 18 shows a cylinder head mold in which the cope flask also is used as a core arbor on which the cores are assembled. The cores are assembled by girls in the core room and gaged from the pin holes. The molder sets the core by closing the drag over the cope on close fitting pins and then rolling both over.

Good Bottom Boards

A bottom board usually receives only passing notice, although it may be quite a factor in the making of good castings. This is especially true in thin section work where speed and accuracy are combined. A good molder may be able to place a warped plate and wedge it up so it will not clamp off if he is given enough time, but where molds are rammed by unskilled labor and at high speed, straight boards or plates are absolutely necessary.

FIG. 19—THESE CASTINGS ARE MADE IN A FOUNDRY THAT HAS DISCONTINUED ENTIRELY THE USE OF GAGGERS

A bottom board or plate may be built of wood, steel plate or cast iron. Boards made out of well seasoned white pine will stay straight for quite a while and answer the purpose on certain jobs, but on a straight production job a metal plate is the most satisfactory and the most economical. Steel plates with angle or channel cleats are favored by a great number of foundrymen. They are usually lighter than cast plates, which is in their favor, but it is almost impossible to keep them straight. Where accuracy is desired I still prefer the cast iron plate wherever it is possible to use it. To avoid machining and still overcome the small irregularities of a cast plate, pads about 3/32-inch thick are put on the plates, as shown on the plate in Fig. 15. It is only necessary to true up these pads to insure a good bearing against the flask. If later on the plates should develop a warp the pads may be reground. The pads should be placed so that in clamping the mold, the clamps can be placed directly over them.

For best results it is necessary that the different bars in a flask come within the limits intended when set over the pattern. Special caution therefore must be exercised in machining the flask and in drilling the pin holes. It is good practice to machine the joint of the flask and drill the pin holes from the bars, using certain bars for locating points, rather than from the outside of the flask or from the unfinished joint where irregularities are the rule on the average flask.

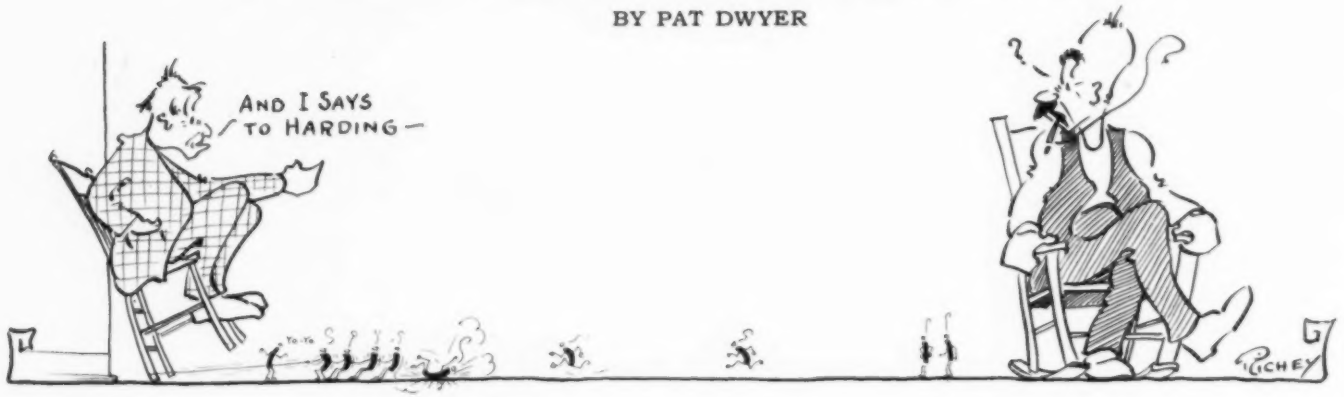
To Deoxidize Aluminum

Robert J. Anderson, metallurgist of the Bureau of Mines, Pittsburgh, is examining methods suggested for the deoxidation of aluminum and its light alloys. The presence of aluminum oxide in the metal or in its alloys seems to lead to defects of various kinds; and a study is being made with a view to obtaining, if possible, a commercial deoxidizer. Preliminary experiments have been made with the use of misch metal (ferrocerium), and with boron suboxide for the deoxidation of aluminum-copper alloys. The former material appears to possess some possibilities, and further experiments are to be made.

The first bridge in America consisting of cast-iron throughout, was built over the Erie canal at Frankfort, N. Y., in 1840 by Earl Trumbull.

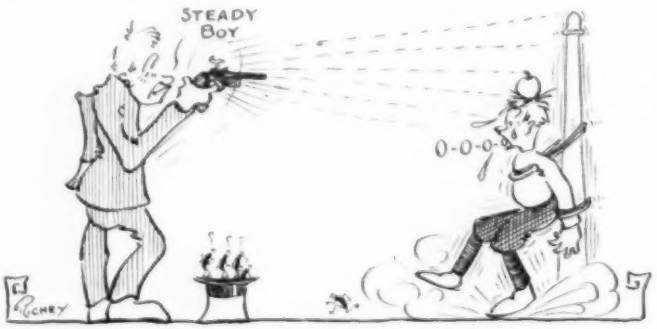
Bill Casts a Hub On a Steel Wheel

BY PAT DWYER



PROBABLY on account of the fact that I have not yet attained to a state of perfection and therefore am full of frailities and human weaknesses, I find two classes of men that irritate me exceedingly. On the witness stand and under oath to tell the truth, the whole truth and nothing but the truth, I might be forced to admit that I have been irritated, on occasion, by others; but in the main and taking it by and large, I shall stick to my former statement concerning the two typical persons who have on many occasions almost tempted me to write a scathing letter to the newspaper. The deciding factor that restrained me on each of these occasions was the reflection that evidently neither one of these nuisances ever read the papers and therefore my protest, in so far as they were concerned, would have no effect. In fact I probably only should arouse the ire of some innocent newspaper reader who was not interested even remotely in my point of view or my private quarrel. The net result of all my effort would be represented by a minus sign.

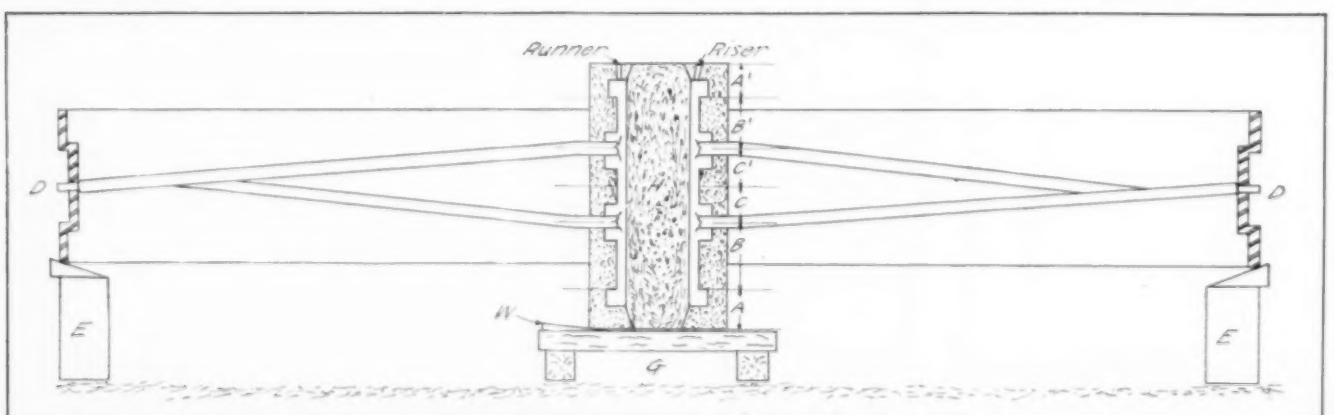
Another factor which had a bearing on my decision to keep out of the newspaper columns hinged on anonymity. You have noted, of course, that when one citizen has felt an overwhelming desire to take a vicious poke at another citizen through the newspaper, he always has used a fictitious signature. The law of libel is comprehensive and far reaching, but like every other law it has its loop holes if one wants to sneak out through them. I don't. Besides, while I never have had any objection to either giving or taking a light tap on the jaw either in peace or war, I always have had conciencious scruples about shooting a man from ambush.



MODERNIZED VERSION OF "WHY DID WILLIAM TELL?"

The first of these men is the lad who tells a story that has been going the rounds of newspapers for years and claims either that he is the hero of the events narrated, or that the hero is a near and dear personal friend. Many times I have wished—vainly of course—but still with a certain degree of pleasure, for those stirring days so eloquently described by that sterling old leather-leg, J. Fennimore Cooper. It is many years since I read his romances and many of the characters and incidents have faded out of my memory; What I had in mind was the form of sport prevalent among the Six Nations—a kind of a big league—known as *running the gauntlet*. All the warriors in the village lined up in two parallel lines about 4 feet apart. The prisoner was supposed to run from one end of the line to the other. It was each warrior's privilege and pleasure to jab him with a knife or take a hack at him with a tomahawk as he fled between the opposing lines. These warriors had a high sense of honor and also of humor for they always advised the prisoner before starting that if he won through to the opposite end of the line he was free to go where he willed.

Cooper, so far as my recollection goes, does not specify that any victim ever



SECTIONAL VIEW OF WHEEL ASSEMBLED READY FOR POURING THE HUB. THE STYLE OF HUB CORE WILL VARY TO A CERTAIN EXTENT DEPENDING ON THE DIAMETER OF THE WHEEL.

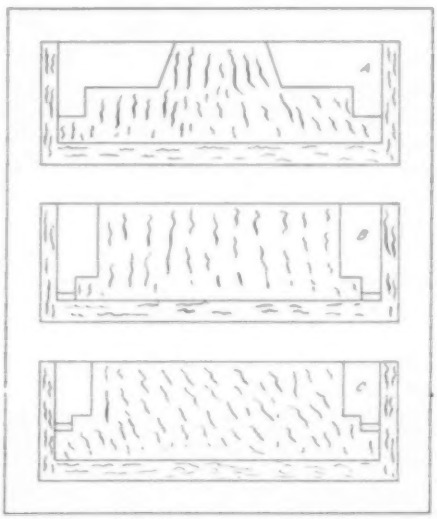
was forced to run the gauntlet as a form of punishment for claiming to be the hero in a story which the remaining members of the company recognized as an old friend of their childhood; but that is no reason for assuming that such a thing never happened. The old romancer had a fertile imagination, but he could not think of every thing. A band of noble red men (the author's words, not mine, thank you,) that would put a stranger to death, simply because he was a stranger, would not balk at making a toreador run the gauntlet. Besides, an event of that character corresponded in a general way with one of our modern athletic meets, a kind of a field day, a holiday and furnished innocent amusement for the women and children. No accurate statistics are available, but, again falling back on J. Fenn., we safely may assume that the mortality records averaged about the same as at present.

When you consider that these innocent and untutored children of the forest invariably referred to themselves in the third person and that they couched their meaning in the longest and most involved sentences available in those days, all I have to say is, that if one of these long winded prevaricators was not forced to run the gauntlet, the members of the band were strangely remiss in their duty and fell far short of Cooper's eulogies.

Imagine, if you can, the gang squatted comfortably on their hunkers around the council fire in the Long House. The calumet is passed around from hand to hand and each chief takes a few contemplative whiffs of the fragrant weed. The talk turns on feats of skill and markmanship. Spotted Dog rises to his feet and having been duly recognized by the chair proceeds to deliver himself as follows:

"Brothers, the snow of many winters lies on the hair of Spotted Dog. He has followed the long trail for many moons, even into the hunting grounds of the Algonquins and the pale faces. Many scalp locks hang in his wigwam and bear silent witness to his prowess with the bow and the long carbine. The smoke talk this evening, brothers, reminds him of an experience he had at one time in the past when he sojourned in the land of the palefaces beyond the great salt water. He had a friend, Billytell, who drew the long bow so skilfully and well that no warrior in all the land could approach him in feats of marksmanship. The great war chief of the Yodellers being highly incensed and jealous of the warrior's prowess ordered him on one occasion to shoot an apple from his son's head, thinking thereby to overwhelm him with shame, confusion and grief. His tongue was forked and while he spoke fair words, praising the warrior's skill with the bow, he felt that the intense emotional strain on the part of the father would cause the strength to depart from his arm and the skill and cunning from his hand and eye. Billytell was in despair and in his anxiety opened his heart to Spotted Dog, who in his wisdom, counseled him in the path he must follow. At the time of the shooting, Spotted Dog, disguised in Billytell's war paint and feathers calmly took up his stand, bent his great war bow and the feathered shaft whistling through the air, pierced the apple fairly in the center so that the halves fell on either side of the stripling. Spotted Dog always will regard that as the greatest feat of archery within his recollection. Brothers, Spotted Dog has spoken."

Here the chiefs all jump to their feet and bury the hatchet in Spotted Dog's neck.

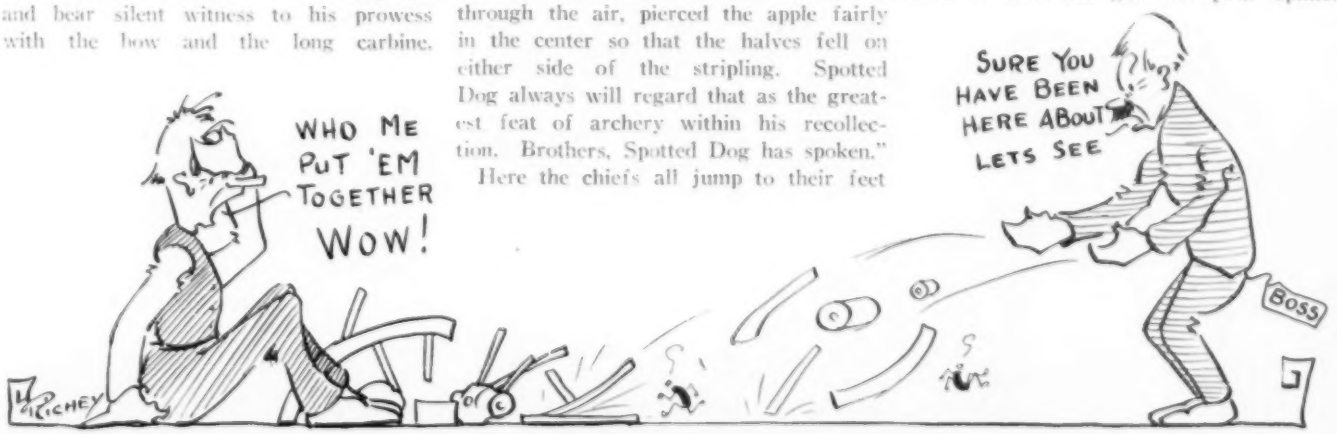


SECTIONAL VIEW OF COREBOX FOR THE CORES SHOWN IN THE PREVIOUS ILLUSTRATION

The second man to disturb my equanimity, to put the case as mildly as possible, is the individual who thinks the world was made the day he was born, and that nothing ever happened before that time. This delusion is quite prevalent among children and of course in their case is rather excusable. Consider for a moment. As far back as you can remember your parents were grown up and in the event that the idea ever has occurred to you, you had difficulty in visualizing them as children. Your reason tells you that at one time in their career they were small and helpless, that they wore little short clothes and had their noses wiped by *their* parents, but can you actually visualize that fact?

However, I have no patience with the clever young fellow who happens to learn of something for the first time, something that has been fairly familiar to others for possibly many years. Because he learns of it for the first time, he calmly assumes that no person ever heard of it before and in a condescending tone graciously hands me information on a subject with which I probably have been familiar before he was born. With a view of discovering whether my mind was warped along these lines and whether other persons are affected in the same manner I asked Bill whether or not he regarded these two classes of people as a public nuisance.

"Well" said Bill "I'll tell you. It all depends on the way I feel. Some times I laugh at a bird of that kind and at other times I willingly would pay any reasonable fine for the privilege of tying a grind stone around his neck and dropping him off the end of the dock. However, at the present moment I have other troubles. I had a letter yesterday from a young foundryman asking me to describe the manner in which cast iron hubs are molded and poured on steel wheels. I have written to him at some length and I wish you would look it over and give me your opinion



FOUNDRY FOREMEN'S INDOOR SPORT, PROVIDING A JOB THAT WILL KEEP THE APPRENTICE AT WORK ALL DAY

before I mail it. I have made the wheels and seen them made many times, but I find that making a job and describing the method and process for the benefit of another person, are two radically different propositions." He handed me the following composition.

The method of forming a typical hub on one of these wheels is shown in the accompanying illustrations in which the first at the bottom of page 506, represents the wheel and hub mold assembled ready for pouring and the second at the top of page 507 shows a sectional view of the three coreboxes required. Six separate cores are employed to form the hub, but since the upper and lower halves of the hub are symmetrical, three coreboxes are sufficient. In some wheels of this character in which the projections for receiving the arms are spaced more evenly, two coreboxes only are needed. In the wheel illustrated the particular method adopted for constructing the coreboxes will depend on the number of castings required. If only one or two wheels are needed a single outside frame is built up of a ring and bottom. Three separate blocks are turned up corresponding to the three different shaped centers. Any one of these centers may be dropped into the corebox to form a desired shape. For instance, when the block *A* is in place the resulting core will be the one to form either the top or bottom of the hub; block *B* will form the core for the intermediate section used for supporting the bottom set of arms and for covering the top set; block *C* forms the pair of cores occupying the space between the two sets of arms. If a large number of wheels are to be made it is advisable to make three complete coreboxes with the center blocks fastened securely in place in each one.

Where these wheels are made on a production basis suitable equipment is provided on the foundry floor for adjusting the cores level and central with regard to the rim. Where only an occasional wheel is made, temporary equipment as shown will serve satisfactorily, provided care is observed in adjusting it accurately. The hub is bored out after it is cast and the hole is truly centered with the rim, but the hub must be approximately in the center in the first place, otherwise the hub will present an uneven thickness after it is bored and in addition the boring tool will encounter the ends of the arms on one side of the hub cavity and probably jump more or less, producing an uneven surface on the interior.

The rim of the wheel is set up level on suitable supports *EE* as shown in the first illustration. These supports may rest on the floor or on a large bottom board. In either event they should be high enough to permit the insertion of a small board *G* on which to assemble the hub cores. The entire set of hub cores first is assembled on a second board, or on the bench and measured for total height, then the rim of the wheel is measured and the board *G* is adjusted in such a manner that the assembled core will project an equal distance above and below the rim. For instance, assuming that the set of cores is 12 inches high and the rim is 8 inches it is apparent that the board must be set 2 inches below the rim. However in cases of this kind it is more practical to measure from the top, therefore a straight edge is laid on the top edge of the rim and the board *G* is adjusted 10 inches below it. Final adjustment is made with wedges *W*.

The core *A* is placed on the board *G* followed by the core *B* containing grooves for the ends of the lower set of arms. The outer ends of the arms, provided with shoulders are inserted in the holes in the rim. Since the lower set of arms comprises only half the total number of arms it is apparent that the ends of these arms must be inserted in alternate holes in the rim. After the arms are set the core *B* may have to be twisted a little so that the arms are on true radial lines. As stated previously where these wheels are made in large numbers this feature is taken care of automatically by a species of jig in which the wheel is assembled. Where the wheel is made in a repair or jobbing shop the man setting it up has to depend on the accuracy of his eye to secure a symmetrical distribution of the arms.

Some times the center cores *C* and C_1 are pasted, to prevent a fin at the joint, but this feature hinges to a considerable extent on the size of the wheel and the peculiar formation of the hub. After the core C_1 is set the upper arms are placed. The ends which engage the rim all are on the same horizontal plane, but the ends bedded in the hub are staggered. This is a feature which must be taken into consideration if the cores *C* and C_1 are pasted. It is apparent that the grooves for the upper arms must come in the center between and above each pair of lower arms. Since the cores *C* and C_1 are exactly alike it is necessary to provide two suitable marks in the corebox if the cores are to be pasted. If they are left separate, of course, the core C_1 is adjusted by measurement and the eye of the molder in the same manner as the core *B*.

In the event that the center core *H* is, what is known in the foundry as a chamber core, that is, one with a projection in the center, designed to lighten the hub and incidentally cut down the hub boring time and expense, it will have to be set before the upper arms are placed in position. In the wheel shown in the illustration, the center core is straight and therefore all the cores except A_1 may be set before lowering the center core into place. The top core A_1 is provided with a runner and riser. It is customary to run a little metal through the riser to carry off any bubbles generated by the ends of the arms projecting into the hub. On small wheels the openings around the arms may be daubed with mud, but on larger wheels it is customary to fill sand around the hub cores and ram it quite firmly to prevent the metal leaking out around the arms. With small wheels and tight fitting cores these precautions are not necessary. The cores are clamped together in the same manner as any other mold before the iron is poured. After the hub casting has cooled the ends of the arms projecting through the rim are riveted over. In the event that the hub is found to be not truly central it is possible to correct the error by riveting certain arms first and thus drawing the hub a trifle more or less in the desired direction.

Many methods are adopted to prevent the metal from *blowing* off the ends of the arms. They are painted with coal oil, red lead, tar, chalk, water glass (silicate of sodium) and tinned. Irrespective of what preparation is employed the ends must be perfectly dry and free of oxide. For an occasional casting it may be sufficient to heat the ends red hot in a fire to remove the scale, then place the ends in the core while still hot and pour the casting immediately. The best and surest method and the one adopted where the wheels are made extensively is to dip the ends of the arms in molten tin and thus secure a coating which will prevent *blowing* and also which will amalgamate with the iron and form a tight joint. For a second choice probably water glass is the most satisfactory. Before applying the water glass the area to be covered should be ground bright on the emery stone, or heated red hot in the forge fire.

"So far as I can see" I said "you appear to have covered all the salient points."

"I'd say I have" said Bill "I know I have gone more into detail than the old man who gave me the first wheel to make. He showed me the rim, the spokes and the stack of cores and said 'there y'are kid let's see if you have sense enough to put 'em together!' "

With intimations that oxygen can be produced at 8 cents a thousand cubic feet, possibilities of its use in place of air or as an addition to the air-blast in the cupola present themselves.

Investigates Brass Problems

Government Air Service Maintains Chemical, Physical and Metallographic Laboratories To Control Operations in Its Experimental Nonferrous Foundry McCook Field—Melting Temperatures Closely Regulated

BY E. H. DIX

UNTIL recently the foundry has not received earnest consideration from scientific and technically trained men. For example, it is only within the past few years that it has been possible to measure the temperature of molten metals by a satisfactory method. Even at the present time, the old time foreman is skeptical as to the real paying value of technical methods. In part this attitude is just, because there have been many instances where new methods have been tried and discarded, perhaps through faults, through lack of a thorough understanding of their application, or both.

Certain classes of work still can be made satisfactorily by the old methods, but to meet the demands of aircraft construction the practical foundryman needs the aid of the latest scientific methods, and instruments in the hands of technically trained men. In other words, strict technical control must be exercised in the foundry as it is in the heat-treating room and in other branches of industry.

In order that the engineering division of the U. S. air service might obtain information relative to foundry problems at first hand, a small experimental foundry was established at McCook field, Dayton, O. At first the work consisted chiefly of experimenting with the test bars of various nonferrous alloys. However, it soon was realized that in order to be of practical value, the scope of the foundry would have to be enlarged so as to make actual castings of the alloys experimented with. From this it was a short step to supplying all of the nonferrous castings for the large machine shop building experimental parts for aircraft. Patterns of dubious design are tried out in this foundry and the difficulties remedied before the work is let out on contract.

As the foundry is under the direct supervision of the metallurgical branch of the material section, it has at its disposal the services of technically trained men and all of the latest equipment. As a result, a system of technical control has been built up which should be of more than passing interest to the practical man, even though the demands on his product may be less exacting.

Melting Equipment

The new equipment of the foundry is shown in Fig. 1. From left to right these furnaces are: A stationary crucible furnace, a crucible tilting furnace, and another stationary crucible furnace, all arranged for oil or gas fuel. Recently a 10-inch electric crucible was installed. This is shown in the foreground of Fig. 2. This furnace is a recent development of the induction type electric furnace, the heat being generated directly in the metal by a high frequency current. For metals of high conductivity, such as copper and aluminum, a special crucible is used and in this case the crucible walls

FIG. 1—MELTING DEPARTMENT IS EQUIPPED WITH CRUCIBLE FURNACES

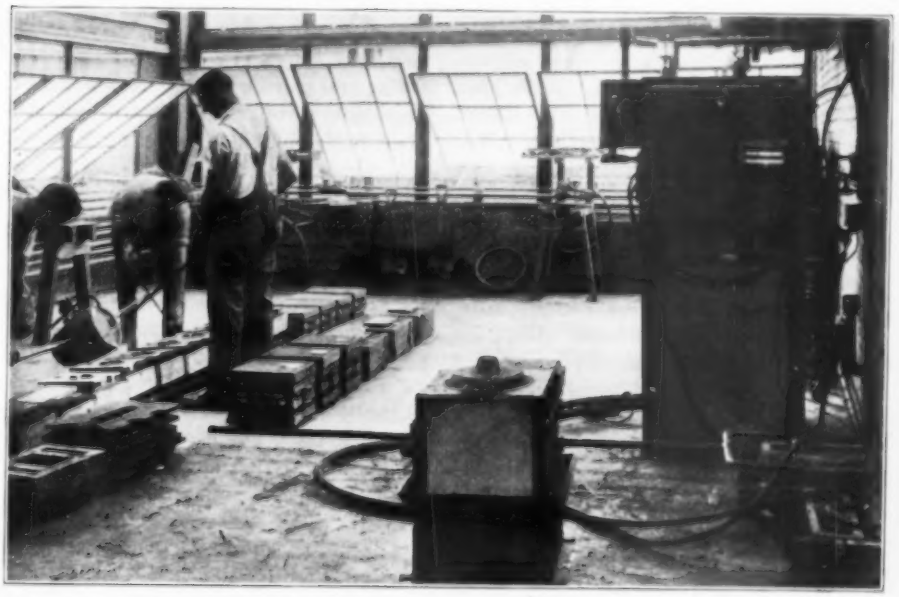


FIG. 2—A SMALL ELECTRICAL CRUCIBLE FURNACE IS SHOWN IN THE FOREGROUND AND AN ELECTRICALLY HEATED CORE OVEN AT THE RIGHT

Paper presented at the annual meeting of the American Foundrymen's association, held in Rochester, N. Y., June 5 to 9. The author, E. H. Dix Jr., is a member of the engineering division of the air service located at McCook field, Dayton, O.

are heated by induction. This furnace is capable of attaining exceedingly high temperatures and is desirable for the manufacture of hardeners containing metals of high melting points. An electrically-heated core oven with thermostatic control may be seen at the extreme right of Fig. 2. This oven is desirable for experimental core work.

The technical control of the foundry may be grouped under the following headings: Temperature control, chemical analysis, physical testing, and metallographic examination. These four headings are discussed separately.

The advantage of careful temperature control cannot be too strongly emphasized. The maximum furnace temperature and the pouring temperature strongly influence the structure and physical properties of all metals and alloys. This is particularly true of aluminum alloys in which case it is known that the lower the pouring temperature, the more dense the structure and the stronger the alloy. It is true that the experienced melter handling the same metals day after day becomes expert in judging temperatures, but there can be no doubt that differences in atmospheric conditions will cause even the most experienced to fall down at time in judging the correct temperature of the metal. For instance, a pot of aluminum alloy which looks red in the comparative darkness of the furnace room assumes a dull silvery lustre when taken out into the sunlight. Bright and cloudy days produce corresponding differences in the appearance of the metal. Also, where a number of difficult alloys are handled, the judgment of the correct temperature becomes increasingly difficult.

Temperature Control

It is possible at the present time to measure the temperature of molten aluminum satisfactorily in several different ways. The ordinary base metal thermocouple wire may be used in a light wrought iron or cast iron protecting tube. This is satisfactory if the thermocouple is to be allowed to remain in the bath of metal, as for instance, in holding furnaces. However, if a quick reading is desired, the protecting tube produces too great a lag and is not satisfactory. For a quick reading, a couple made up of a constantan wire enclosed in a light iron tube and welded to it at the end has been found satisfactory. In this instance the iron tube acts as one element of the thermocouple and at the the same time as a protecting tube. Although the manufacturer does not recommend its use in molten aluminum without a protecting tube, it has been found in our foundry to give satisfactory results. Recently we have been using chromel-alumel wires of No. 6 gage without any protecting tube. These wires are spread apart above the weld about 4 inches so as to prevent short circuiting through the metal. The weld, of course, burns off after a number of readings have been taken, but the wires can be re-welded until completely used up. This couple gives an even quicker reading than the iron-constantan couple but it liable to error due to short circuits across the metal.

For measuring the temperature of brass and bronze, the protecting tube presents a much greater problem inasmuch as the temperatures are higher and it is difficult to obtain an alloy which will not be attacked by the brass or bronze. However, a protecting tube with a tip made of a chromium alloy recently has been perfected which gives highly satisfactory results. Any type of base metal couple can be used in the tube, but in our foundry the chromel-alumel wire is used exclusively.

All of these couples are used in conjunction with a millivolt meter of the high resistance type. Flexible leads of the same material as the couple are used so that the cold junction is carried to the meter. The meter is located in a relatively cool place and thus the error caused by cold junction variations is small. The couples are frequently checked by the freezing point of salt. Fig. 1 shows the temperature of a pot of aluminum being taken.

The maximum furnace temperatures and pouring temperatures shown in the accompanying table have been adopted for the usual run of work, although, of course, they are varied to suit unusually heavy or very thin castings.

Chemical Analysis

The chemist is essential for the satisfactory operation of the foundry. He carefully analyzes the raw material which is always purchased according to definite chemical specifications. He analyzes the rich alloys made up for introducing metals of relatively high melting points and the proportion in which these hardeners are used is based on his analyses. Finally, he analyzes the alloys as fixed to determine if the metals are in their proper proportion and to see that an unduly large amount of impurities has not been introduced during the melting.

The physical testing laboratory furnishes the ultimate check on the quality of metal produced. Unfortunately, it seldom is possible to test the actual castings produced in the foundry because to do this would be to destroy the casting. It therefore is necessary to make tests on special bars cast from the same metal, and therein lies the greatest difficulty in connection with the testing of casting alloys, that is, to obtain a specimen truly representative of the metal. Many erroneous conclusions have been drawn through the use of faulty test bars. It is the usual practice with large castings to cast, as an integral part of the casting, a coupon from which is machined the test bar. This test bar is required to meet certain physical specifications. The experienced foundryman knows that he can obtain various physical properties in the test bar, depending upon its location with respect to the gates and

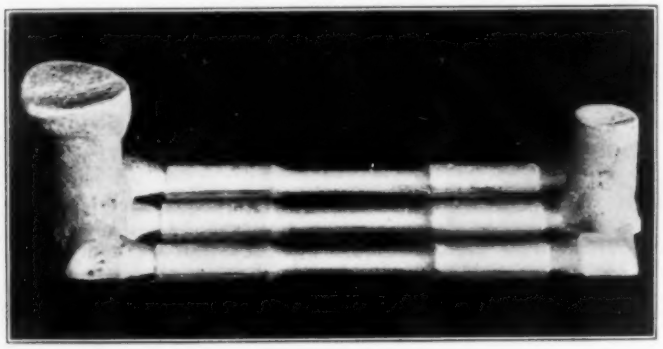


FIG. 3—ALUMINUM TEST BARS ARE CAST THREE ON A GATE WITH A LARGE FEEDER HEAD

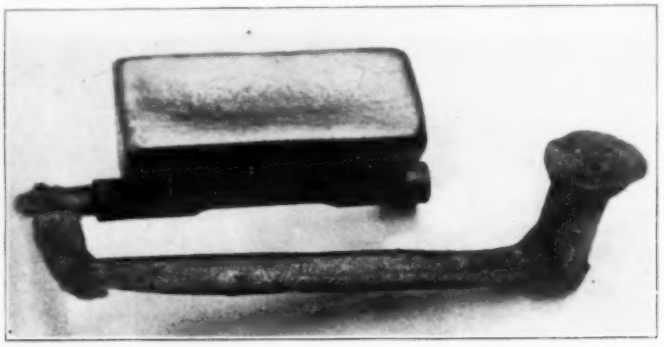


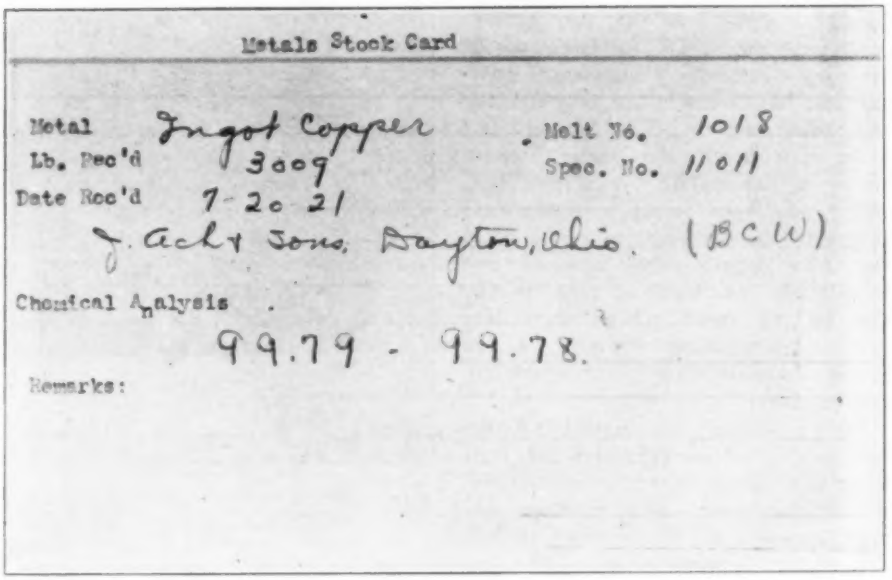
FIG. 4—IN CASTING TEST BARS OF MANGANESE BRONZE A LARGE BODY OF METAL IS USED TO FEED THE BAR AS IT COOLS

risers. Thus, to meet a certain specification the manufacturer can select the position on the casting which will allow the test bar to meet the specification. Specifications usually require that the location of the test bar shall be agreed upon between the inspector and the manufacturer, but of course the manufacturer, having much more experience in this connection, can easily persuade the inspector that his selection is the correct place for the test bar. Thus, instead of being concerned with improving his product to meet the specification, he is dodging the specification by outguessing the inspector.

Separate Test Bars

For the past year, the material section has been much concerned with standardizing the method of casting the test bars of the nonferrous alloys used in aircraft construction and has adopted several which have been found to give satisfactory results. The choice of a method of casting test bars should be based on simplicity, uniformity of results, and results as nearly as possible comparable to values obtained in actual castings. In regard to this last item, it must be realized that no test bar can represent the physical properties of different parts of a casting because physical properties vary from section to section, depending upon the thickness, the proximity to gates and risers and upon whether in the bottom or top of the casting. After taking all of these things into consideration, it has been decided that the separately cast test bar is much more satisfactory than the bar which is cast as an integral part of the casting. By adopting a separately cast test bar the method of gating may be specified once and for all, and this cause for disputes between the inspector and the manufacturer will be eliminated. By adopting a uniform method, data will gradually be accumulated which will result in fair specification values for different alloys.

In order to furnish information for the designers, it is the policy of the foundry from time to time to cut small test bars from castings and to compare physical properties of these with the results obtained from the standard test bar cast from the same melt. These tests give average figures which are satisfactory for parts designed with a large factor of safety. However, in the design of aircraft parts, it is always necessary to reduce the weight to the absolute minimum; therefore, the castings must be designed with a more intimate knowledge of the physical properties obtained.


Metals Stock Card

Metal Ingot Copper Melt No. 1018
Lb. Rec'd 3009 Spec. No. 11011
Date Rec'd 7-20-21
J. Ach & Sons, Dayton, Ohio. (BCW)
Chemical Analysis
99.79 - 99.78.
Remarks:

FIG. 5—A COMPLETE RECORD IS KEPT OF METAL STOCK—THIS INCLUDES THE RESULTS OF THE ANALYTICAL TESTS

The following procedure is suggested for important castings which are highly stressed. The casting is designed and the pattern made up from the best available knowledge of the physical properties of the alloy to be used. This pattern is then turned over to the foundry and three or four castings made, using as many different methods of gating as may be deemed necessary. These are poured all from the same melt of metal from which also is poured a mold of standard test bars, and the pouring temperature is carefully noted. It sometimes may be necessary to try several pouring temperatures in order to select the one giving the strongest and soundest castings. The castings then are tested in a manner which duplicates the service condition as nearly as possible. From the results of these tests it is possible to decide whether the casting is strong enough to meet the requirements for which it was designed and at the same time to determine which method of gating gives the best results. If one of the methods of gating produced a casting which would satisfactorily meet the requirements, then it is merely a matter of seeing that all castings on that order are gated in the same way and poured at the same temperature and the standard test bars cast from each melt are at least as good as the test bars cast from the experimental heat.

Red Brass and Gun Metal

Fig. 3 shows the methods of casting test bars of aluminum alloys, which has been definitely adopted by the foundry for all experimental and inspection work. This method is simple, requires a small amount of metal, and gives uniform and depenable results, which, while usually slightly higher than test bars cut from castings, yet are not sufficiently high to be misleading to designers. The middle bar may be omitted if desired. This same method is being used for red brass and gun metal. It seems to be perfectly satisfactory for red brass, but with gun metal it has been noted that the middle bar is frequently much stronger than the two outside bars. It is suggested that the reason for this is that the metal flows directly from the pouring head down through the middle bar and

Furnace and Pouring Temperature

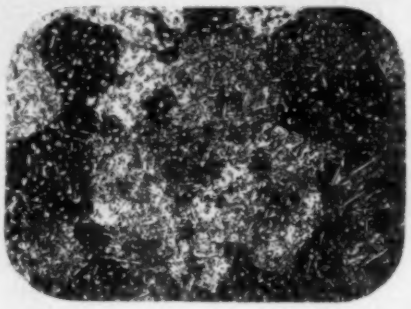
Alloy	Melting point liquidus, degrees Fahr.	Maximum furnace temperature, degrees Fahr.	Pouring temperature, degrees Fahr.
Cu 8, Al 92	1128*	1400	1200 1300
Cu 10, Al 90	1130*	1400	1200 1300
Cu 85, Sn 5, Zn 5, Ph 5	1780†	2000	1950
Cu 88, Sn 10, Zn 2	1825†	2200	2050
Cu 80, Sn 10, Pb 10	1735†	1950	1900
Cu 60, Zn 37+3 Hardener	1600†	1800	1700 1750

*From the equibrium diagram given in the *Bulletin* of the American Institute of Mining and Metallurgical Engineers, No. 150.
†From *Technical Paper* No. 60 of the bureau of mines.

does not flow into the two outside bars until it begins to back up in the riser. Recently a number of comparisons have been made between the test bars cast in this manner and those cast from the same pattern, but with the middle bar stopped off, and it has been found in every case that with the bars cast two in a mold the two results are uniform and consistently as high as the middle bar of the mold where three are cast together. One or both of the outside bars of this latter mold are usually low.

Fig. 4 shows the method adopted for manganese bronze and other high shrinkage alloys after a great deal of experimenting. The complete results obtained in these series of experiments may be found in a paper by the author presented at the 1921 meeting of the American Society for Testing Materials.

METALLOGRAPHIC RECORD



J. O. -- E.O. 805-2
Composition (As Mixed) Cu 59.62, Zn 40.0, Sn .58, Mn 0.47, Fe 1.14, Al 0.99,
(Analysis) Fict.Zn 46.0

Melt No. 540 Spec. No. 1
Pattern No. TS-2B
Pouring Temp. ° F. 1750

Yield Point, lb. / sq. in.	45,470
Ten. Str., lb. / sq. in.	83,770
Elongation, %	22.5
Red. of Area, %	24.44
Brinell	156
Scler.	24

DESCRIPTION:

Alpha particles precipitated from grains originally beta. "Purple Constituent" noted at 1000 X.

Plate No. 2111-A
100 X

Etching $NH_4OH + H_2O_2$

FIG. 6—FULL INFORMATION CONCERNING A CASTING IS SHOWN ON THE CARD WHICH CONTAINS A MICROGRAPH OF THE METAL.

COMBINED DATA SHEET FOR CASTING ALLOYS

FOUNDRY RECORD

Alloy. Mn Bronze — Date Cast 2-1-21
Composition Cu 56.6, Zn 40.0, Fe 1.25, Sn 0.50, Melt No. 540
Specification No. 11021 Al 1.00, Mn 0.61 J.O. 601 E.O. 805-49

Charge:

Material	Melt No.	Composition	% of Charge	Weight Lbs.
Cu	495	99.60 pure	54.10	25.80
Hardener	530	See below	5.41	2.58
Sn	526	99.70 pure	0.50	0.24
Zn	5	99.95 pure	40.00	19.07
		Total		47.69

Flux: None
Furnace Ller Fuel Oil Time in Furnace. 2 hrs. 10 min.
Max. Fur. Temp. °F. 1800 Pouring Temp. °F. 1750 Test Bar Pattern No.
Remarks: Analysis of Hardener Cu 46.6; Mn 11.33, Fe 23.10, Al 18.90.
Bars cast with 1/4 in. gate.

E. H. Dix, Jr.

TESTING RECORD

Date Tested 2-3-21

Specimen marked	1	2	3	Aver.	Aver.
Type of Specimen	Machined - Th'd End				
Orig. Dia. In.	.502	.502	.502		
Yield Point, Lbs. sq. in.	45,470	38,900	34,380	39,580	
Tensile Str. Lbs. sq. in.	83,770	83,370	84,480	83,980	
Elong. in 2 in. %	22.5	20.5	23.5	22.2	
Red. of Area %	24.44	23.89	26.69	25.01	
Location of Fracture	M.T.	O.T.	O.T.		
Character of Fracture					
Brinell 500 kg	156	156	159	157	
Scleroscope	24	24	24	24	
Specific Gravity	8.24				

Remarks:
O.T. Outside Third
M.T. Middle Third

E.R.Moore

CHEMICAL ANALYSIS

Element	Cu	Sn	Mn	Fe	Al	Zn
	56.80	0.57	0.47	1.14	0.99	40.0 Dif.
	56.84	0.57		1.14		
Remarks:		0.59				

A.C.Zimmerman.

FIG. 7—THE COMBINED DATA SHEET GIVES RESULTS OF BOTH CHEMICAL AND PHYSICAL TESTS AS WELL AS A HISTORY OF THE HEAT

It often happens that the chemical analysis is entirely satisfactory and yet the physical properties are below standard. In such cases it is necessary to turn to the metallographic examination of the alloy for an explanation. This subject is far too broad to permit a discussion at the present time, but it may be stated that the foundry obtains microphotographs of the structures of test bars as a matter of routine record. These are carefully filed and in the course of time will furnish satisfactory information relative to the value of metallography as a branch of technical control of the foundry.

Correlation of Tests

The most important part of the technical control is the correlation of the four branches just discussed. This can only be obtained by careful and accurate records. The forms used in the foundry are reproduced in Fig. 5 to 8. Fig. 5 is the stock card. As soon as metal is received from outside or made up in the foundry for future use, it is entered on this card. It is identified by a melt number. The melt numbers are consecutive numbers given to each pot of metal melted in the foundry or each lot of materials received from the outside. The complete information relative to any melt is given on the foundry log sheet, having the corresponding melt number. This form is shown in Fig. 8. Fig. 7 is a combined data sheet containing the information from the foundry log, the physical test results, and the chemical analysis; thus, the full information is contained on one sheet and it is not necessary to look through

several sets of files to obtain this information. Fig. 6 shows the form used for the metallographic record. This also contains the physical properties and chemical analysis of the specimen photographed.

Technical control is a tool to aid the practical skill of the foundryman; it is not black magic which can replace long years of toil over the fires. Implicit faith in the pyrometer may lead to more rejected castings than the total absence of any temperature measuring device. A pyrometer in the hands of a novice cannot take the place of an experienced melter, for even with the best of care pyrometer installations have the habit of getting out of order just at the time they are most needed. But if in the hands of an experienced melter, a loose connection or a partially burned out weld, causing a reading a hundred or more degrees low, is quickly detected and the difficulty remedied. The writer has known of a gray iron molder heating aluminum to 1700 degrees Fahr. merely because the pyrometer failed to reach the 1300 mark that he was instructed to carry it to.

Also, no amount of work in the chemical, physical, or metallographic laboratory can replace watchful care and knowledge wrought of long experience in the foundry, but the laboratory work can be made of such great assistance in meeting the difficult problems of the foundry as to much more than pay for itself on a dollars and cents basis, besides being an absolute essential in meeting air service requirements.

Foundry Log

Alloy Mn-Bronze Composition Cu 56.62, Zn 40.0, Fe .425, Sn 0.50, Al 1.00, Mg 0.61 Specification 11021 Date 4-1-21 Melt No. 590

CHARGE DATA

Metal	Melt No.	Composition	% of Charge	Weight Lb.
Cu	495	99.30% pure.	54.10	25.70
Hardener	530	See Melt Sheet 530.	5.41	2.57
Sn	328	99.70 pure	0.50	0.24
Zn	5	99.95 "	40.00	19.07

MELTING DATA

Temperature Meter No. 15339 Couple Chromel-Alumel Max. Furnace °F. 1100 Pouring °F. 1150
Time Started 9.45 Ready 11.55 Poured 11.55 Flux Charcoal

CASTINGS

Part No.	J. O.	E. O.	Number Wanted	Cast	Accepted	Weight Each Lbs.
TR-2B	601	665 47	2	3	2	1.2

REMARKS: Experimental Melt.
Melted in open coke fire. Poured in open sand mold. Metal was very fluid. Top part of casting was distorted.

FIG. 8—THE FOUNDRY LOG SHEET CONTAINS A FULL HISTORY OF THE PRODUCTION OF A LOT OF CASTINGS

How and Why in Brass Founding

By Charles Vickers

Making Copper Tuyeres

Please send us information regarding blast furnace tuyeres to be made of copper. We want to known how to design the coreboxes, make and mold the patterns, and to melt the copper, also what flux to use.

Regarding the patterns and coreboxes, all tuyere patterns are not the same. Therefore, it will be necessary to have blueprints, and if the prospective customer cannot supply them, perhaps he would sell or loan a scrap tuyere from which the necessary information as to size and shape could be obtained. After this information has been furnished, get in connection with a good jobbing patternmaker, and have him make the patterns, either from the blueprints or from the casting. The patternmaker will know just how to make both pattern and corebox, and then there will be no losses due to make-shift patterns and ill-fitting cores. A tuyere is anything but an easy casting to make. Therefore, it will pay handsomely to have a skilled patternmaker make the patterns in the best possible manner, so nothing is left to chance as far as pattern and coreboxes are concerned.

In regard to molding, two ways of making the average tuyere are possible. Sometimes they are made with the small end down, and again with the small end up. In the one case the core is suspended in the cope, and in the other it is stood on the drag and the cheek closed over. Both ways produce good castings. When the core is suspended in the cope and the molten copper is introduced at the bottom of the mold, the gases generated within the core are driven out upwards before the rising metal, whereas with the core in the drag the gases have to back through that part of the core immersed in the metal as it rises. For that reason there is a greater tendency to blow when the core is stood on its prints in the drag. The core referred to more particularly is the water jacket core, which is ring shaped. A first-lass coremaker is required to make this core because it has to to be thoroughly vented. Otherwise it will blow with astonishing ease. The core sand also should be free venting and the binder must burn away readily and leave the sand loose so that it can be extracted from the casting. Tuyeres from which it has been impossible to extract the cores have been cast. The cores and the mold must be made of an open sand so rammed that the gases can readily escape, as the thin wall of metal rises between them. Should there be any simmering, leaky castings will occur.

Use charcoal when melting the copper and, at the start, use all ingot copper. After experience has been gained in this work, it will be time enough to experiment with the cheaper scrap metals. Melt the copper and get it hot and for a deoxidizer use 1 per cent of a 10 per cent silicon-copper, or about 4 ounces of phosphor copper, as thought best. If experience with copper castings is lacking it will pay to run a few preliminary heats, making some small castings that can be tested by water pressure. This will probably save a mold or two later.

Melting Monel Metal in Tilting Furnace

We have been trying to melt monel metal in an ordinary oil-fired, crucible tilting furnace, with poor success. It is the belief of the inquirer that this furnace will not produce sufficient heat, and also that the ordinary brass melting crucible would be short-lived. Upon trying to melt with this equipment, the heat was on seven hours and the metal was so dull it gummed on the pouring ladles. We melted under charcoal and salt, and deoxidized with magnesium, using 1½ ounces per 100 pounds of metal. We used the same gating and shrink heads as for manganese bronze. We will appreciate your suggestions.

It will be evident if this is the best the furnace will do that it is entirely unsuited for making castings of monel metal; because it is ruinous to keep it under heat seven hours, without getting it to a pouring temperature. The cause of the failure probably will be found to be that the crucible is too large and holds too much metal for a high temperature to be attained with the burner used, although it is satisfactory for brass and bronze. The melting point of monel is 2480 degrees Fahr., and in order to pour castings it will have to be superheated considerably beyond this temperature. The temperature of steel rising in a mold has been found to be 2775 degrees Fahr., and the monel will have to be between 2500 and 2600 degrees, and close to the latter figure to run it properly. It is our opinion you will not be successful with this tilting furnace, that it will be necessary to install others more suitable. We suggest that steelmelting crucibles be used in preference to brass melting crucibles and that the crucibles be pulled out and used to pour. For heavy castings use more than one crucible. Heavy feeders are required. Gates should permit the metal to enter without agitation. A refractory facing is required for the molds. The great difficulty encountered with this metal is cracking, but a little study will overcome this.

Hot Mill Bearings Break

We have made bronze bearings for hot mills for a number of years, using the standard bearing bronze 80-10-10 and they have always given satisfaction. Of late excessive working pressures have been used, and complaints have been received that these bronzes are breaking. A competitor informed one of our customers that he could put in a nickel bronze at about five cents per pound more than had been paid and that this bronze would eliminate their troubles. We would appreciate receiving such a formula in order to make a test of our bearing against those of our competitor.

Your competitor is mistaken in his contention that a small percentage of nickel will make a stronger bronze at the working temperature of a hot-mill bearing. His nickel bronze will break just the same as the alloy that has been used. The value of nickel in a bearing alloy is due to the fact that when a considerable percentage of nickel is used, more lead can be added, which makes a more plastic bearing. In the case of a hot-mill bearing the lead cannot be increased, otherwise the bronze will break all the easier, nickel or no nickel. If the bearings have failed because of more severe working conditions, nothing more can be obtained from any alloy of copper, tin and lead, even though nickel is added. Should this statement be doubted simply add from 2 to 5 per cent nickel to the 80-10-10 alloy deducting the nickel from the copper. If the same working pressures are maintained, the nickel bronze will break about the same as the bronze minus nickel. Cutting the lead below 10 per cent will not strengthen the bronze at the working temperature of a hot-mill brass. If the excessive working pressures are going to continue, the best bronze that can be used, because it will not break, is an aluminum bronze, but it will have to be thoroughly lubricated all the time.

Castings To Withstand Heat and Pressure

We are planing to make castings that must withstand 250 pounds working steam pressure, with 100 degrees superheat, and we are looking for a suitable bronze formula. We wish to know if manganese bronze is a good material for this purpose, also if a material listed in Kent's Mechanical Engineers' Pocket Book and known as gun metal is satisfactory. This bronze is copper, 88 per cent; tin, 10 per cent and zinc, 2 per cent.

Manganese bronze is not suitable for the purpose stated; the alloy 88-10-2 is more suitable than manganese bronze. The following modification of 88-10-2 will be found an improvement:

	Per cent
Copper	87.99
Phosphor copper	.10
Tin	9.50
Zinc	2.00

Place the phosphor copper in the bottom of the crucible and melt the copper with it, using charcoal as a covering. This alloy will stand the heat and pressure as well as any ordinary bronze that can be made, although it will be inferior to a metal high in nickel. Copper-tin alloys are not suitable for superheated steam service as they rapidly and progressively lose strength with temperature rise. However, 1 or 2 per cent of nickel would make little difference in the alloy. The nickel must be high, thus monel metal is a suitable alloy for use in connection with superheated steam.

Aluminum Is Pitted When Poured Too Hot

We have experienced considerable trouble in making aluminum closet seats. The pattern is ⅛-inch thick. We use a fine grade of sand and employ an advertised flux on the metal. The molds are left open a while before they are poured to take some of the dampness out of the sand and we use the sand rather drier than usual. Little holes appear on the surface of the aluminum after it is polished. We should like if possible to have the surface of the seat polished like nickel.

The little holes are caused by pouring the metal too hot. If one eighth inch thickness is too small to permit the aluminum to be poured when it shows, at the most, faintly red, then it would be advisable to increase it to 3-16-inch. Flux never should be used in connection with melting aluminum; a little sal ammoniac sometimes is scattered on the surface after the aluminum has melted. Aluminum differs from brass and bronze in that a foreign covering is not needed while it is melting. Aluminum forms its own covering. The most important feature of melting aluminum is to keep it from getting too hot; never at any stage of the melting should it be allowed to attain an orange color.

Leaving the molds open to air dry is of no advantage. If it is felt that drying the molds helps the metal to run, spray them with molasses water and skin dry them with a gasoline torch just before they are poured. Should they be skin dried as they are made and then closed the dampness will strike back to the surface. An alloy with nickel and copper will show whiter than No. 12 but aluminum cannot be made to resemble nickel as the metal has a bluish color.

Desires a Soft Aluminum Alloy Casting

We have some aluminum castings to make that must be soft and bend easily. They must also be made of an alloy of low specific gravity. Can you give us a suitable mixture? Also, can we use scrap metal?

The most suitable metal to use in this case is virgin aluminum without any mixture of any kind. If virgin aluminum is too soft, use an alloy of virgin aluminum 96 per cent; magnesium 4 per cent.

It is evident that scrap metals cannot be used for this purpose.

Sand Talks Excite Members' Interest

(*Concluded from Page* 483)

terest was so great that it was decided to hold an adjourned meeting the following day. Mr. Bull also presided over this meeting, which was opened by a second paper by Mr. Doty. In this paper on testing green sand bond strength he emphasized the importance of grain size and shape in giving strength to sand in molds. In the discussion which followed the effect of water, necessity of proper ramming and value of rounded grain were emphasized.

In the absence of its author, H. B. Hanley reviewed the paper on the significance of screen test of molding sand which was prepared by H. A. Schwartz, National Malleable Castings Co., Cleveland

Report Malleable Tests

THEORY of the changes which take place in annealing malleable iron and results of numerous tests were discussed in two papers before the session devoted to malleable cast iron at which C. R. Messinger, presided, Friday morning. Reading a paper prepared by himself and H. E. Gladhi, both of the University of Michigan, A. E. White cited the results of tests made to determine the influence of temperature and composition on the graphitization of white cast iron. Experiments were made by holding samples at definite temperatures until equilibrium had been reached. These tests showed that a small amount of silicon has a marked effect on the time necessary for anneal, a sample with 0.90 per cent silicon requiring only 4 hours to reach equilibrium at 1800 degrees Fahr., and 20 hours at 1600 degrees, while a sample containing 0.60 per cent silicon required at these temperatures 10 and 60 hours respectively.

The second paper, dealing with the theory of the anneal of malleable iron showed that temperature has a marked effect on the form and character of graphite particles of the annealed iron. It was read by the author Edward J. P. Fisher, Worcester, Mass.

H. W. Highriter, Eastern Malleable Iron Co., Naugatuck, Conn., read the report of the American Foundrymen's association committee on specifications for malleable cast iron citing that at a joint meeting of the committee on malleable castings of the American Society for Testing Materials and the American Foundrymen's association committee on specifications for malleable iron castings it was decided that the present specifications be changed to require an ultimate strength of 50,000 pounds per square inch and 10 per cent elongation in 2 inches instead of 45,000 pounds and 7.5 per cent now required. It also was decided to change the gage length of the test bar from 6 inches to 2½ inches, including fillets.

The possibility of regulating the air and powdered coal so as to prevent the use of a great excess of either was indicated by D. M. Scott, the T. H. Symington Co., Rochester. In his paper Mr. Scott advocates the use of carbon dioxide recorders to determine the proper amount of air to use. In answer to a question by E. E. Greist, he said he had obtained around 19 per cent carbon dixoide in the gases of combustion while 18.3 per cent is the theortical. James Kittle, Ohio Malleable Iron Co., Columbus, O., said he had not been able to secure more than 16 per cent carbon dioxide in the gases of combustion in an oil-fired furnace.

Data secured from the use of powdered coal in melting and annealing furnaces were given in a paper by E. E. Greist, Chicago Railway Equipment Co., Chicago. Mr. Greist said that while 10 years ago powdered coal was used in a number of malleable iron annealing ovens it was only recently that this fuel have been adapted successfully to melting, but that now a number of foundries are melting iron with powdered coal. A discussion of a method of determining the most economical coal to use is included in the paper. History of a number of heats shows that uniform melting time is secured by the use of powdered coal. The best iron to coal ratio secured by Mr. Greist was said to be 4.28 to 1 for annealing and 3.87 for melting. Mr. Greist said he had not been able to obtain more than 17.5 per cent carbon dioxide in the flue gas.

Refractories were discussed at this session in two papers, the one on the manufacture and properties of refractories for air furnaces by C. E. Bales, Louisville Fire Brick Co., Highland Park, Ky., and the other on the behavior of fire brick in malleable furnace bungs by H. G. Schurecht, bureau of mines, Columbus, O.

Live Industrial Queries

ALTHOUGH the four papers and one committee report included in the program of the industrial relations session held Wednesday afternoon covered a wide range of subjects, they related appropriately to the broad topic of prevention of industrial waste. The keynote paper, which was to have been presented by L. W. Wallace, executive secretary Federated American Engineering societies, Washington, was briefly summarized by Dean Clifford B. Connelley, head of the department of labor and commerce, state of Pennsylvania, Harrisburg, Pa., who presided. Dean Connelley deplored the great preventable waste caused by improper planning and control of production, cancellations of orders, spoiled and defective work resulting from faulty inspection lack of proper cost control systems, unstable relations between employer and employe, etc. In referring to the problem of industrial relations the speaker declared that special wage methods are almost wholly futile in the absence of standardization and system in work.

In introducing his address on business economies, Ernest F. Du Brul, general manager, National Machine Tool Builders' association, Cincinnati, epmhasized the importance of leveling off as much as possible the *peaks* and *valleys* of production in basic industries. "The fundamental cause of depressions," he declared, "is that too many business executives are perhaps woefully, if not wilfully ignorant of some important phases of business management."

"Time Studies and Job Analysis in the Foundry" is the title of an important paper presented by A. J. Kramer, International Harvester Co., Chicago. Mr. Kramer outlined a practical system of time study, explaining why it is justified by results.

Buell W. Nutt, Safety Equipment Service Co., Cleveland, showed moving pictures which illustrated in an unusually clear and striking manner the common defects in human vision.

B. D. Fuller, vice president Niagara Wall Paper Co., Niagara Falls, N. Y., presented the report of the A. F. A. committee on safety, sanitation and fire prevention indicating progress being made by various organizations working with the American Engineering Standards committee in formulating a safety code.

THE FOUNDRY

Registered U. S. Patent Office

A semimonthly journal devoted to all branches of the foundry trade

Published by
THE PENTON PUBLISHING CO., CLEVELAND

BRANCH OFFICES

BOSTON.....476 Old South Bldg.
CHICAGO.....1147 People's Gas Bldg.
CINCINNATI.....501-505 Commercial Tribune Bldg.
HARTFORD.....P. O. Box 1231
NEW YORK.....2203-2206 St. Paul Bldg.
PITTSBURGH.....2148-49 Oliver Bldg.
SAN FRANCISCO.....8 Monadnock Bldg.
WASHINGTON, D. C.....84 Home Life Bldg.

FOREIGN OFFICES

BIRMINGHAM, ENGLAND.....Prince's Chambers
LONDON, ENGLAND.2-3 Caxton House, Westminster, S.W. 1
PARIS, FRANCE.....224 Rue de Rivoli
Cable address, IROTRAPEN, London

SUBSCRIPTION

United States and Mexico.....$3.00 a year
Canada.....$4.00 a year
Great Britain and other Foreign Countries.....$4.00 a year
Single Copies.....25 cents
Copies published three months or more previous to date of current issue, 50 cents each.

ADVERTISING

All communications relating to advertising copy, discontinuances, etc., must be received on the 1st and 15th of the month preceding date of publication.

Member, the Audit Bureau of Circulations and Associated Business Papers Incorporated
Entered at the Post Office at Cleveland as Second Class Matter

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Labor Shortage Impends

IN THE larger foundry centers, notably in those where automotive manufacture predominates, a labor shortage is at hand. Detroit, Toledo and Chicago particularly report a scarcity of day laborers for foundry work, while workmen capable of handling molding machines and the other more skilled work of a castings plant are becoming more difficult to find. This labor famine is remarkable, when the recent unemployment crisis is remembered. The condition is not temporary by any means. With restricted immigration, the curves representing the balance between immigration and emigration gradually have been descending toward the horizontal which represents equilibrium; that is one foreigner leaving for every one arriving. Further, as pointed out by C. R. Messinger, president-elect of the American Foundrymen's association in an address at Rochester, the immigration at present largely is made up of Jewish people from Central Europe and a dearth of Polish, Hungarian and other sturdy types which go to make up foundry labor, is noted. With a continuance of this condition, the foundry industry will be forced to adjust itself. The smaller foundry, located outside of the larger cities will not be affected as strongly as will the larger production shop; but the effect, none the less will be universal. The problem must be faced by practically every foundry manager and that within a short time. The answer will be sought through a greater use of labor saving machinery and equipment and through broadening the appeal of foundry occupations. Ways must be found to attract younger workmen, and conditions of labor must be scrutinized to remove unfavorable features.

Call for Standard Sand Tests

WHILE progress in industry is continuous, it usually is marked by steps taken after conditions have worked up to certain points which make the advance possible. It clearly was indicated at the convention of the American Foundrymen's association that the foundry world is deeply interested in and about to take one of these steps. A demand is made for standard methods for testing sand. The foundryman seeks to replace the crude tests now employed through want of more definite means of determining the properties of his sand. Already one steel foundry is making tests of its molding sand twice a day and finds that these tests distinctly denote the condition of the sand, permitting improper conditions to be corrected before the sand has reached the condition in which it will affect the castings injuriously. Thus sand tests will prevent disaster which otherwise might not be detected until several heats of steel had been poured and excessive scrap made. Sand tests also will give the foundryman a language in which he can talk to the sand producer and indicate what qualities he must have. Not so many years ago all pig iron was graded by fracture and little or nothing was known about the chemical composition of the iron or the effects of the different elements on the properties of the metal. As soon as analytical methods were developed and study was made of their effects on the iron, a few foundrymen began to buy and mix their iron by analysis and slowly the practice spread until now it is practically universal in this country. Standard sand tests will find a hearty welcome in the foundry industry and it will not be long after they are developed until they are in general use by foundrymen.

Trade Outlook in the Foundry Industry

JUNE has brought continued fair weather in the industrial world and the foundry industry in particular has been favored. Improvement in many lines, notably in building construction, railway extensions and repairs and in automoitve lines has been followed by a steady growth in castings orders and a consequent improvement in foundry operations. So great has been the increase and so marked the change, that in a number of larger centers, notably Toledo, Detroit and Chicago an actual labor shortage exists in castings plants. No doubt, some of this condition is temporary and may be attributed to the great migration of working men during the stress of unemployment last winter; but day laborers are likely to continue scarce.

Automotives Keep Promise

That the improvement in purchases of automobiles was based upon something more than a cumulative whim of the buying public, has been demonstrated. A flood of orders still continues to pour into the manufacturing centers. One maker is more than six weeks behind on deliveries, while a popular medium priced car cannot be had under sixty days. The reflex is evident in the automotive castings plants, many of which are operating on full schedule for the first time in more than eighteen months. Truck production also is increasing, and while tractors are lagging behind, the demand is much better than had been anticipated, and likely will continue to improve. Farmers are buying implements in greater numbers. In the Northwest an actual shortage of some types of farm implements is reported. For this reason, and through lower freight rates and slight advances in crop prices, tractor builders anticipate better business as the season advances. Harvesting machinery, an important factor in furnishing castings demand is expected to be more readily sold this fall than for several years past. Sales of commercial cars in the rural districts are accentuated this season.

Building Grows

No slackening is apparent in building construction, although in a few of the large cities, labor disputes again have hampered operations. Commercial, industrial and office building construction is growing steadily. This is shown by the structural awards, which during the month of April, according to the census bureau, reached 90 per cent of the structural steel capacity, based on an estimate of two-thirds of the shop output. The total for April was 177,660 tons as compared with 139,300 tons for March. Residence construction, likewise, is expanding. According to the department of commerce, orders received for bath tubs during April total 107,566 as compared with 63,815 for March and only 32,625 for April, 1921. A corresponding increase is noted in the orders received for sinks, lavatories and other sanitary ware. This increase is reflected in foundry operations, sanitary ware, plumbing goods, furnace, stove and radiator shops continuing to work to capacity. Pipe foundries also are busy, supplying service lines to take care of the great growth in residence construction, and public utilities.

Iron Still Advances

Pig iron production, perhaps one of the most accurate barometers of general industrial conditions and foundry operations in particular, registered a large gain in May. According to statistics compiled by *The Iron Trade Review*, the total iron output for May was 2,309,348 gross tons, which compared to the April total of 2,070,161 tons gives a gain of 239,187 tons. On a daily production basis, the output of both merchant and non-merchant iron during May was at the rate of 74,495 tons per day, giving a gain of 5490 tons per day over the April daily average of 69,005 tons. The total of merchant iron produced in May was 410,404 tons, which compared with the April figure of 375,814 tons gives an increase of 34,590 tons. On a daily average basis the May total showed 13,239 tons or an increase of 712 tons per day over the April average of 12,527 tons. Furnaces operating on the last day of May totaled 175 as compared with 151 on April 30. This record is second to January, 1921, when 184 furnaces were in blast. Merchant furnaces in operation increased from 37 to 42 during the month. That is, nine were blown in and five were blown out in that period. Railway purchases have continued strong during May and well into June. During May, 18,240 cars were ordered. This is not as great as the April total of 31,490 cars, but still it marks a total in excess of the preceding three months and gives an aggregate for the year of 88,225 cars ordered. Further, the first weeks of June have seen inquiries for 4000 cars in the West and further 3000 inquiries for repairs are extant.

Prices of Raw Material for Foundry Use

CORRECTED TO JUNE 12

Iron		Scrap	
No. 2 Foundry, Valley	$24.00 to 25.00	Heavy melting steel, Valley	$17.50 to 17.75
No. 2 Southern, Birmingham	18.50 to 19.00	Heavy melting steel, Pitts.	17.00 to 17.50
No. 2 Foundry, Chicago	23.00	Heavy melting steel, Chicago	14.50 to 15.00
No. 2 Foundry, Philadelphia	24.84 to 26.32	Stove plate, Chicago	15.75 to 16.75
No. 2 Foundry, Buffalo	26.82 to 27.26	No. 1 cast, Chicago	17.25 to 19.00
Basic, Valley	25.00	No. 1 cast, Philadelphia	18.00 to 19.00
Basic, Buffalo	23.00 to 23.50	No. 1 cast, Birmingham	13.00 to 14.00
Malleable, Chicago	23.00	No. 1 cast, Buffalo	18.00 to 18.50
Malleable, Buffalo	22.50 to 23.50	Car wheels, iron, Pittsburgh	16.50 to 17.00
Coke		Car wheels, iron, Chicago	18.25 to 18.75
Connellsville foundry, coke	$7.00 to 7.50	Railroad malleable, Chicago	16.50 to 17.00
Wise county foundry, coke	6.00 to 6.50	Agricultural mal., Chicago	16.50 to 17.00
		Railroad malleable, Buffalo	17.00 to 17.50

Nonferrous Prices

With the generally improved tone in brass and aluminum casting demand better operations are reported. Nonferrous prices, based on New York quotations in the *Daily Metal Trade* of June 12, follow: Casting copper, 3.37½c, electrolytic copper, 13.87½c; Straits tin, 31.62½c to 31.75c; antimony, 5.25c; lead, 5.75c to 5.87½c; aluminum, No. 12 alloy, producers' price, 19.00c to 19.20c and open market, 16.00c to 16.50c. Zinc is 5.42½c E. St. Louis. May average prices for nonferrous metals follow:

(New York Quotations)

Casting Copper	Electro. Copper	Lead	Tin Straits	Antimony	Aluminum 98-99	Zinc St. Louis
12.848	13.40	5.547	30.935	5.431	17.983	5.108

Comings and Goings of Foundrymen

HENRY LUCIEN REASON, elected president of the Institution of British Foundrymen at the Birmingham meeting, was born in Paris, where his father, an Englishman, was then resident. During his childhood the family removed to England. He served his apprenticeship with Hayward Tyler, Ltd., Luton, a concern specializing on hand and power pumps, hydraulic machinery and steam and water fittings. Afterward, he became works manager of Blundells, Ltd., Limehouse, London, general and marine engineers, iron and brass founders and coppersmiths and manufacturers of ash hoists. Removing to Birmingham he took a similar position with John Russell & Co., Ltd. On leaving these firms Mr. Reason received several mementos expressive of esteem from those who had worked under him. Two years ago he became general manager of the works of the United Brassfounders & Engineers, Ltd., at Holloway Head, Birmingham.

For many years past Mr. Reason has been an enthusiastic member of the Institution of British Foundrymen, having held the position of president of the Birmingham branch for two periods, 1911-13 and 1919-20. He received a diploma from the Institution for his contribution on "Nonferrous Alloys" during the session of 1914-15. He was one of the first directors of the Nonferrous Research association.

Mr. Reason is a member of the Institute of Mechanical Engineers, the Birmingham Metallurgical society, and the Institute of Metals, serving for some time on the council of the latter association. Several papers have been contributed by him to various institutions and engineering societies on such subjects as brassfoundry practice, copper alloys, the melting of nonferrous alloys, etc.

During the war Mr. Reason rendered valuable expert service, being a member of a special committee set up by the air board in connection with the standardization of aircraft fittings. Report No. 66 issued by the Engineering Standards committee which comprised representatives of the Civil engineers, mechanical engineers, naval architects, electrical engineers, and other bodies makes special recognition of the pioneer work undertaken on their behalf by Mr. Reason, and of the value of the information furnished by him, which formed the basis of the report.

In connection with the formation of the British Cast Iron Research association it should be placed on record that Mr. Reason took the initial steps of bringing before the Institution of British Foundrymen the matter which set up a special subcommittee, and

H. L. REASON

upon their report the Institution of British Foundrymen called a meeting of the trade in conjunction with the British government's industrial research department and the British Cast Iron Research association was formed. Mr. Reason acted as honorary secretary of the new association until the present secretary was elected. He now represents the Institution of British Foundrymen on the principal committee of the research organization.

Edward Fiest, formerly superintendent of the Monarch Foundry Co., has been appointed to a like position with the Michigan Gray Iron Castings Co., Detroit.

J. M. Ryan, Stuart Mfg. Co., Chicago addressed the monthly meeting of the Pittsburgh Foundrymen's association, Monday evening, May 15. The subject of his address was "Bearing Metals".

A. D. Halporn, who for some time has been associated with the Philadelphia sales staff of the Combustion Engineering Corp., has been made a member of the New York sales force of this company.

O. H. Dallman, formerly of the Vanadium Alloy Steel Co., Latrobe, Pa., and the mechanical department, Pennsylvania railroad, Chicago, has joined the sales force of the Independent Pneumatic Tool Co., Chicago.

William H. Woodin, president of the American Car & Foundry Co., returned to this country May 20 after attending the International Railways conference at Rome. Mr. Woodin recently has been elected a director of the American Ship & Commerce Corp.

Mr. Harry Naylor, for many years plant manager United States Radiator Corp., Corry, Pa., and until more recently manager the American Castings Co., also of Corry, has been appointed assistant manager of the Niagara Radiator & Boiler Co.'s new Chicago plant.

C. A. McCune was elected president of the American Welding society at the annual meeting of that society held recently. Mr. McCune has been prominent in the affairs of the society for some time, having served as chairman of the membership committee.

L. Blackwood, managing director of L. Blackwood & Son, Ltd., dealers in engineering specialties, Sydney, Australia, is making a business tour of the United States not only in the interest of his own company but also that of Hadfield's (Australia) Limited, manufacturer of electric steel castings. Mr. Blackwood is a director of this company.

Book Review

Grinding Machines, by Thomas R. Shaw; cloth, 114 pages, 4 x 6¼ inches; published by Isaac Pitman & Sons, Ltd., and furnished by THE FOUNDRY for 85 cents.

The author sets forth in concise form the main principles governing cylindrical grinding. He points out that the subject matter furnished the basis for a series of lectures given by him at the Royal Technical college, Salford, England. The various natural and artificial abrasives are explained followed by a short description of grinding wheel manufacture, the bonding processes employed, etc. Cylindri-

cal grinding machines next are described. This chapter is illustrated profusely with line drawings and reproductions from photographs. The illustrations include machines of American as well as British make. The principal subjects treated in this chapter are the proper relation of turning to grinding, work speeds, the universal grinding machine, the universal head, the tailstock, platens and slides, feeds, grinding tapers, disk and face grinding, internal grinding, plain grinding machines crankshaft grinding, form grinding, cam grinding, roll grinding, centerless grinding, internal grinding, etc. Surface grinders next are discussed.

The construction details of grinding machines form the basis of another interesting chapter. The author points out that present-day manufacturing methods call for both quality and quantity and that grinding machines must be able to produce accurate work when put to severe use.

In a chapter devoted to the care and operation of grinding machines, the author gives a table of grinding limits for various cylindrical pieces, including allowances for sliding, standard, drive and force fits. A handy reference table is included giving the correct speeds to operate wheels ranging from 1 to 50 inches in diameter to attain surface speeds of 4000, 4500, 5000, 5500, 6000, 6500 and 7000 feet per minute.

Interesting data pertaining to grinding wheel wear are given it being stated that with correctly graded wheels it has been proved that wheel wear on external grinding machines is proportional to wheel diameter. The result of some tests showed that a 14-inch wheel removed an average of 8 cubic inches of metal per cubic inch of wheel wear when employed on a precision grinding operation, whereas a wheel 24 inches in diameter removed 19 cubic inches of metal per 1 cubic inch of wheel wear.

Device May Be Attached to a Chain Hoist

Recently the New Jersey Foundry & Machine Co., 90 West street, New York City, has placed on the market a portable machine that may be carried from place to place and used to operate various hand hoists by simply hanging it in the bight of the operating chain. It is intended for use on hand operated equipment where it is desired to obtain faster and easeir operation than obtainable by hand requiring the service of but one man and where it would not be worth while to install a standard electric hoist. It is claimed that this portable electric machine is capable of overhauling 138 feet of chain a minute with a chain pull of 150 pounds. This is about four times the speed of a chain pulled by hand. The machine is made up of a cast iron housing containing a hardened worm and worm gear running in oil and driven by a ¾-horsepower motor attached to the frame. The worm wheel shaft is extended and carries a chain sheave with a rubber tread that will fit any size and pitch of operating chain without slipping. The entire outfit is counter balanced so that it hangs with the center of gravity in the plane of the operating chain. Current may be supplied by a flexible conductor from convenient sockets or suspended from the hoist if it is more desirable to bring feeders to that point. A plug socket is mounted on the machine for attaching flexible conductor and a reversing switch is provided by which the motor may be run in either direction, hoisting or lowering.

New Paris Correspondent Chosen

VINCENT Delport has been appointed French correspondent of THE FOUNDRY on account of the resignation of F. M. Mansfield. Mr. Delport also has charge of the Paris office of the Penton Publishing Co., at 224 Rue de Rivoli, where he will represent the other Penton publications including *The Iron Trade Review, Daily Metal Trade, Abrasive Industry, Marine Review and Power Boating.* After being educated as a mechanical engineer at one of the leading French technical schools, Mr. Delport, who is partly of English extraction, entered the iron and steel business. With the outbreak of the war he joined the French army in which he saw active service as a captain of artillery for several years. Later in the war on account of his technical training and knowledge of English he was attached to the French military mission in the United States with which he served until the end of the war traveling extensively throughout the country.

At the end of the war he returned to France and later came back to the United States to join the sales force of the United States Steel Products Co. in New York. After a period in this company's headquarters, Mr. Delport was transferred to the Paris office of the Steel Products company, where he remained until the spring of 1921, when he resigned to form a partnership with H. E. Mathe under the name of Le Bureau Industriel Franco-Anglais, an engineering and contracting firm in which he still is interested.

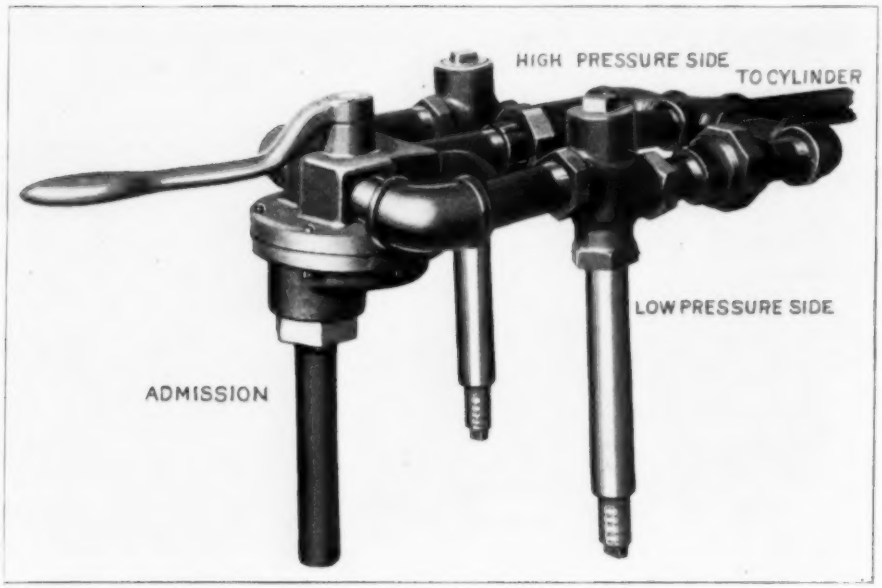
A. W. Ferguson has been made sales manager for the E. J. Woodison Co., Detroit. Mr. Ferguson formerly was sales manager for the Blystone Mfg. Co., Cambridge Springs, Pa., and previous to that time was associated with the A. C. Dutton Lumber Corp. Poughkeepsie, N. Y.

Equipment Firm Acquires New Side Line

New officers chosen by the F. A. Coleman Co., Cleveland, are: F. A. Coleman, president and general manager; C. G. Johnson, vice president and sales manager; P. E. Hand, secretary; F. C. Gensler, treasurer; Spencer A. Coleman, assistant treasurer. Mr. F. A. Coleman formerly was vice president and general manager, and Mr. Gensley formerly was assistant secretary of the Foundry Equipment Co., Cleveland. Mr. Johnson was connected with the Lakewood Engineering Co., Cleveland. The F. A. Coleman Co. recently purchased the Advance Engineering Co. and will continue the latter firm's line of clam shell buckets in addition to the miscellaneous line of foundry equipment.

Valve Adjusts Pressure on Air Squeezer

Squeezing a mold to any desired pressure, lower than the initial pressure, may be accomplished through the valve and regulator shown in the accompanying illustration, made by the Canton Pneumatic Tool Co., Canton, O. It is claimed that this device eliminates guess work and wasted air. When using two regulators as shown, the operator may secure two pressures in addition to the initial



BY THE USE OF A DOUBLE REGULATOR THE AIR PRESSURE MAY BE ADJUSTED TO ANY POINT BELOW THE INITIAL PRESSURE

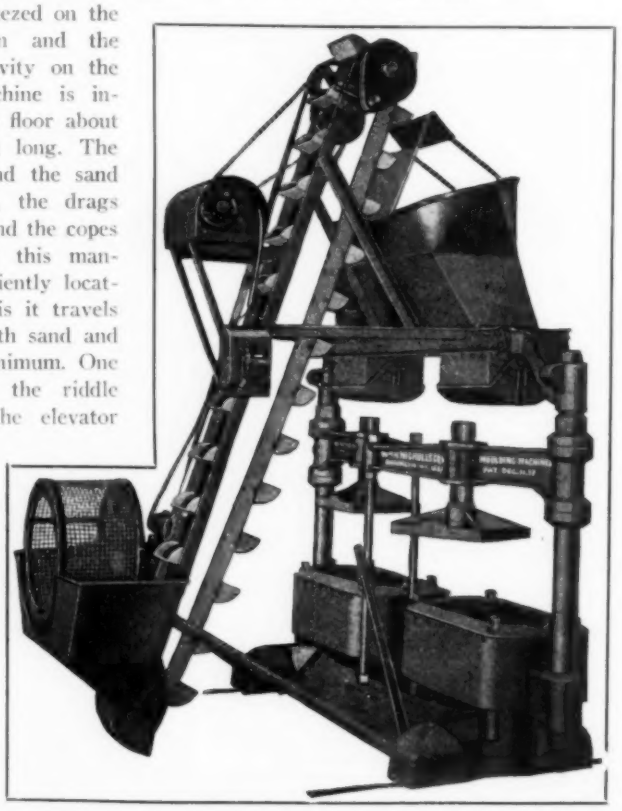
pressure. When using only one regulator in connection with the valve, the initial pressure is secured by turning the handle in the opposite direction. The regulator is calibrated so that no pressure gage is required and to adjust the pressure to any desired point it only is necessary to turn the adjustment screw in or out. A disk type of service valve with no packing is employed. Air enters the bottom of the valve and passes through a fine screen before entering the valve chamber. The regulator has neither auxiliary valve nor diaphragm. It is essential that the regulator be used in connection with the service valve, because the air exhausted from the ram does not return through the regulators, but passes through a connection leading to the service valve. The service valve weighs 8½ pounds and all the openings in the device are tapped for ¾-inch pipe.

Molding Machine Fills Flask With Sand

Several interesting features characterize a type of molding machine shown in the accompanying illustration developed by the Wm. H. Nicholls Co., Inc., Brooklyn. The first one of these machines was designed for and installed in a prominent Michigan foundry a short time ago. The second machine was shown at the recent exhibition held in connection with the convention of the American Foundrymen's association in Rochester, N. Y., June 5-9. The machine shown in the accompanying illustration primarily is designed to meet peculiar conditions in foundries running on long production jobs, but not equipped with either sand or mold conveyors. Briefly the installation comprises two stripping plate molding machines adjusted on a portable base mounted on four wheels, a riddle, a sand conveyor and a double boot hopper provided with suitable gates for permitting the sand to fall into the flasks. The extreme top of the conveyor is about 10 feet above the floor.

This self contained unit mixes and conveys the sand into the flask, jolts and squeezes the mold and draws the pattern. The mold is squeezed on the up-stroke of the piston and the pattern is drawn by gravity on the return stroke. The machine is intended for a long narrow floor about 20 feet wide by 80 feet long. The molds are shaken out and the sand piled in two long rows, the drags on one side of the floor and the copes on the opposite side. In this manner the flasks are conveniently located close to the machine is it travels along and handling of both sand and flasks is reduced to a minimum. One man shovels sand into the riddle which discharges into the elevator feeding the hopper over each machine. The molds are lifted off the machine and set on the floor in the wake of the machine as it travels along on rails bedded in a concrete floor. Power for operating the riddle and elevator is supplied through a flexible cable plugged in along the wall. The hopper arrangement on this machine fills the flasks almost instantly, it is stated, and in addition one operator can fill both flasks and jolt them while the second operator is finishing the mold on the floor or setting cores. Each machine is operated separately with one valve for jolting, squeezing and drawing the pattern. The equipment is well adapted for continuous pouring; in fact flexibility is claimed as one of its principal assets.

After the first of molds made are poured and shaken out, the machine may be picked up by the crane, carried back over the molds and sand heap and set up once more at the front end of the floor. In event that the shop is not equipped with a crane, as in the case of many malleable foundries, it usually is possible to provide a floor long enough to keep the machine busy until after the first heat is poured, or until noon, when the molds may be shaken out, the machine turned and worked back over the floor in the opposite direction.



SELF CONTAINED UNIT LIFTS AND RIDDLES SAND, JOLTS AND SQUEEZES THE MOLDS

The temporary directing committee of the American Construction council has called a meeting of all men interested in any branch of the construction industry to be held in Washington, June 19 and 20. The object is to bring together for co-operation in behalf of the industry and of the public all the elements of construction activity. Secretary of Commerce Hoover will preside.

June Equipment Sales Steady

Buying Deferred Pending the Rochester Convention in Many Cases Was Executed at the Exhibition—Labor Shortage Presages Increased Demand for Machinery

JUNE as a foundry equipment selling month at least is holding its own and compares favorably so far with May, which for several foundry equipment and supply sellers was the best month this year. During the presence of numerous interests at the American Foundrymen's association convention and exhibition at Rochester, N. Y., a more or less steady disposal of equipment and supplies was maintained in the various districts and signal success attended the efforts of salesmen of foundry equipment producers at the show itself. While for two or three weeks before the convention sales sheets represented a sizable aggregate it now is evident that many buyers deferred action until the time of the exhibition and while in Rochester placed their orders for sand cutters and mixers, sand blast machinery, blowers, air compressors, grinders, etc. Sales of smaller equipment such as riddles, wheelbarrows, flasks and kindred supplies are noteworthy.

Chicago Equipment Demand Light

WITH dealers and users of foundry equipment largely present at the Rochester convention and exhibit of the American Foundrymen's association comparatively little activity in this market is apparent. Users appear to be waiting to see what is offered at the exhibits before placing orders for further machinery. However, some business has been done. Demand for ladles of various sizes is coming to makers of this class of equipment and some heavier installations are also being taken. A No. 5 cupola has been sold by the Whiting Corp. to the Nagle Engine & Boiler Co., Erie, Pa. The same seller has booked four tumbling barrels for the Lycoming Motors Corp. at Williamsport, Pa., and a 2-ton hand power crane from Carrothers & Pilburn, at Woodward, Okla. Manning, Maxwell & Moore have bought from this interest a No. 5 cupola for export. The American Manganese Steel Co. recently placed an order for a large dimension tumbling barrel.

Eastern Situation Bright

WHILE trading in the eastern equipment market during the early part of the month was a trifle slower, this was attributed in a large measure to the near approach of the Foundrymen's convention and exhibition at Rochester, N. Y. In a number of instances, action on inquiries was put off until that time and all in all, there was a general tendency to wait until buyers could meet sellers personally and could better size up the equipment on exhibit, especially with regard to new improvements. Nevertheless, there has been a much better feeling in the trade generally. While actual buying, at least up to the time of the foundry convention, had suffered a slight setback, there has been a substantial improvement in inquiry. The bulk has been comprised principally of single machines, presumably for replacement purposes. Nevertheless, there is more equipment now being figured upon for plant additions and even new projects, although the latter are still relatively few, than there has been in sometime. One of the latter projects is a new foundry for Swinton & Co., Port Jervis, N. Y. A considerable addition is to be erected at the plant of the National Boiler Co., Garwood, N. J., and although a list has not as yet been issued, it is expected shortly. A recent buyer in this district is the Central Foundry Co., New York city, which is still in the market for a sand cutting machine and one or two other items. The New York Central railroad is obtaining tentative prices on equipment for its proposed foundry construction at West Albany.

Pittsburgh District Active

ONE or two negotiations still are under way for cupolas and core ovens in the Pittsburgh district. Molding machine sales continue numerous, mostly to foundries located at points some distance from Pittsburgh, some recent orders originating as far west as Denver, Colo., and as far north as Hamilton, Ont. The National Bronze & Aluminum Foundry Co., Cleveland, recently entered the market for molding machines as well as other miscellaneous foundry equipment and the Titusville Iron Works Co., Titusville, Pa., issued a tentative list of foundry equipment and machines for a proposed foundry on South Perry street, that city. The National Transit Pump & Machine Co., Oil City, Pa., recently bought some equipment for its new addition and an Irwin, Pa., foundry likewise closed on a fairly large list with a local house. Recent crane orders from foundry sources have been few, although hoist orders, particularly to the Shepard Electric Crane & Hoist Co., Montour Falls, N. Y., have been fairly numerous. That company recently took orders for two 10-ton cranes with 80-foot span and 10 electric hoists from the Virginia Bridge & Iron Co., Roanoke, Va.; one 3-ton crane and one hoist from the Jones & Laughlin Steel Co., South Side, Pittsburgh; one 3-motor cage-controlled 2-ton crane and one cupola charging hoist from the Fox Furnace Co., Elyria, O.; a crane trolley and hoists from the Morrow Mfg. Co., Wellston, O.

What the Foundries Are Doing

Activities of the Gray Iron, Malleable, Steel and Brass Shops

The plant of the Arkansas Foundry Co., Little Rock, Ark., recently was damaged by fire.

Part of the plant of the American Brake Shoe & Foundry Co., University and Thirty-seventh avenues, Minneapolis, recently was damaged by fire. It is understood it will be rebuilt.

Operations have been resumed in the plant of the Gartland-Carroll Foundry Co., Sandusky, O., which had been closed down since November, 1920.

The Belle City Malleable Iron Works, Racine, Wis., is reported planning the erection of some

plant additions as well as the making of numerous improvements to its existing buildings.

The Bessemer Gas Engine Co., Grove City, Pa., is reported planning the erection of an addition to its plant.

Part of the plant of the Reed Foundry & Machine Co., Kalamazoo, Mich., recently was damaged by fire.

Four plant buildings, including a foundry, will be erected by the Buckeye Castings Co., Lima, O.

The Portsmouth Stove & Range Co., Portsmouth, O., plans the erection of a plant addition.

Plans for the erection of a foundry, 40 x 40 feet, are being drawn by Thomas Savill's Sons, Philadelphia.

Work has been started on the erection of a plant addition, one story, for the Illinois Pure Aluminum Co., Lamont, Ill.

Capitalized at $50,000, the Art Bronze & Iron Works, Danville, Pa., recently was incorporated by D. J. Reese and others.

A site at Hibbing, Minn., has been purchased by the Munising Foundry Co., Munising, Mich., on which it plans the erection of a foundry building.

The Buffalo Foundry & Machine Co., Buffalo, has acquired the coppersmithing business formerly conducted by W. A. Case & Son Mfg. Co., Buffalo.

A group of buildings has been purchased by the Edro Richardson Brass Co., 318 North Halliday street, Baltimore, which it is understood will be utilized as a plant.

Erection of a plant addition, 35 x 60 feet, is planned by the Kermath Mfg. Co., 5880 Commonwealth avenue, Detroit, manufacturer of marine engines.

Fifteen acres have been purchased at Hammond, Ind., by the New York Car Wheel Co., Buffalo, on which it plans the erection of a plant.

Capitalized at $50,000, the Keating Valve Co., Springfield, Mass., recently was incorporated by Henry L. Bowles, Charles S. Vining and Richard J. Talbot.

Construction of an additional 1-story plant unit, 76 x 138 feet, is contemplated by the Western Foundry Co., 3634 South Kedzie avenue, Chicago. The building will be erected at 3654 South Kedzie avenue.

The Service Foundry Co., Beaumont, Tex., has acquired a site on which it plans the erection of a foundry building and pattern shop for the production of iron and other metal castings.

Capitalized at $500,000, the Triplex Machine Tool Corp., New York, recently was incorporated by J. H. Wilhelm, L. E. Larson and J. Cotrule. The company is represented by C. E. Sutherland, 15 Park Row, New York, attorney.

Contract has been awarded to Levering & Garrigues, 552 West Twenty-third street, New York, by the National Boiler Co., South avenue, Garwood, N. J., for the erection of three 1-story foundry buildings. Hooper & Co., 116 Market street, Newark, N. J., are architects.

Erection of a plant building, 60 x 160 feet, to be used for machine shop, cleaning and warehouse purposes is planned by the Ferro Machine & Foundry Co., Cleveland. Contract for the construction of the building has been let to the H. K. Ferguson Co., Cleveland.

The National Bronze & Aluminum Co., East Eighty-eighth street and Luisy avenue, Cleveland, plans the erection of an addition to its plant and it is understood it is in the market for molding machines and other foundry equipment.

Erection of a plant at Michigan City, Ind., is planned by the Sullivan Machinery Co., 122 South Michigan avenue, Chicago, manufacturer of mining machinery, air compressors, etc. A. S. Coffin, 39 West Adams street, Chicago, is architect in charge.

Work has been started on the erection of two buildings, including a foundry, 70 x 110 feet, for the Thomas D. Watson Co., Kingston, Ont. The foundry will be equipped with a 12-ton cupola. A machine shop, under construction, will be the same dimensions as the foundry.

The Connors Machine Shop & Boiler Works, Ltd., Montreal, Que., has been incorporated with $50,000 capital stock to carry on business as iron founder, toolmaker, boilermaker, etc., by George L. Alexander, Wilfrid F. Walsh, William G. Finlayson and others.

Erection of a 1-story foundry addition, 72 x 152 feet, is planned by Swinton & Co., 47 Jersey avenue, Port Jervis, N. Y., manufacturer of stoves, stove castings, etc. Robert Livingston, 2 Rector street, New York, is architect and engineer. J. D. Swinton is in charge of the project.

The Gartland Foundry Co., which some time ago took over part of the old shops of the Chicago & Eastern Illinois railroad at Danville, Ill., expects to start operations about Sept. 1. Improvements to the building and the installation of new equipment involves the expenditure of approximately $100,000.

Work has been started on the erection of a foundry addition, 60 x 210 feet, for the Rundle Mfg. Co., Milwaukee, maker of bathtubs and sanitary ware. The general contractor is Otto C. Randolph, 209 South La Salle street, Chicago, and the project is under the direction of Charles C. Kerwin, Chicago, architect. Henry Held is secretary and treasurer of the company.

Plans of Alfred Box & Co., Inc., Philadelphia, builders of cranes and hoists, call for the erection of a factory building, 110 x 300 feet, with extended runways to accommodate cranes which will handle steel storage. A pattern shop and pattern storage building, 30 x 80 feet, with necessary office accommodations, also is to be built, the additions, which are to be modern in every respect, will enable the company to triple its output, according to G. A. Mitchell, secretary and sales manager.

New Trade Publications

CUTTING TORCH—The Air Reduction Sales Co., New York, has issued a 4-page leaflet in which a cutting torch is described and illustrated. A complete description of the various features of design and construction of this apparatus is given and in addition tables showing the thickness of various metals that can be cut, are also given, as well as the pressures of oxygen and acetylene necessary, and the gas consumption in cubic feet per hour when using tips adapted to cutting steel, cast iron or rivets. Illustrations show sectional views of the torch.

BRONZE PRODUCTS—The American Manganese Bronze Co., Philadelphia, has published a large 36-page illustrated booklet in which various bronze products are described and illustrated. These include castings, ingots, forgings, sheets, rods, rolls, shapes, etc. In addition to this booklet the company has published a number of small leaflets each devoted to describing an individual product. One is on valve stems, another on bronze gears, another on bronze ingots, another on rods and still another on a special bronze having a minimum tensile strength of 105,000 pounds.

BLAST GATES—The Steere Engineering Co., Detroit, has published a circular in which blast gates are described and illustrated. These gates are made entirely of steel. The surfaces against which the disks seat are carefully machined. Two disks are used which are made from steel plate rigidly welded to spacing blocks. When the gate is closed, it is claimed, it is as tight as it is physically possible to make it without wedging mechanism. By removing the bottom plate, the stem and disks can be taken out and the gate completely dismantled without removing it from the line.

ELECTRODE—The National Carbon Co., Inc., New York, has published an 80-page illustrated booklet in which the carbon electrode is described and illustrated in detail. The booklet is not a common trade catalog but really takes on more of the nature of a reference book. It gives a history of the carbon electrode; a history of the electric furnace; characteristics of carbon electrodes; use of carbon electrodes; handling and storage; specifications; furnace records and numerous other chapters on carbon electrodes and their use in the electric furnace.

CRANES—A 4-page illustrated circular has been published by the Whiting Corp., Harvey, Ill., in which cranes are described. These include electric and hand-power travelers; bucket-handling and gantry and jib, pillar and bracket cranes. A number of actual installations are shown.

PORTABLE TOOLS—Black & Decker Mfg. Co., Baltimore, has published a 20-page illustrated folder in which portable tools are described and illustrated. These include electric drills, electric screw driver and socket wrench, electric grinders, safety cleaning machine and electric valve grinder. Capacities, etc., are given.

CASTINGS—The Sivyer Steel Casting Co., Milwaukee, is circulating a small illustrated booklet in which alloy steel castings are described. These include high carbon, vanadium, nickel and chromium steel. Uses to which the various castings are adapted and put are described. The tensile strength, elastic limit, reduction in area, etc., are given for the various kinds of castings.

BENCH SAW—Saw & Knife Specialty Co., Cleveland, has issued a circular in which a bench saw is described and illustrated. This machine is adapted to wood and metal sawing. It has a table top, 13 inches x 15 inches, which can be tilted on either side to any angle up to 5 degrees. It also can be adjusted to any height for grooving, etc. The machine weighs 40 pounds. Equipment includes guides and a saw adapted to both ripping and cross cutting.

BABBITT METALS—The Lumen Bearing Co., Buffalo, has published a small booklet in which babbitt metals are described. In addition to this booklet the company has published a number of others in which attention is called to bronze bearings, bushings, aluminum bronze and machine bronze. Some interesting and valuable data are given in the various booklets.

DIRECT FIRED HEATER.—Skinner Bros. Mfg. Co., Inc., St. Louis is circulating a 12-page illustrated booklet in which a direct-fired heating unit is described and illustrated. This heater is built to withstand heavy usage. All internal parts, consisting of an ash chamber, fire pot, combustion chamber and doors are of heavy cast iron with few joints. The grate bars are triangular in shape with diamond shaped edges, close fitting with extended shaker rod and removable shaker bar. The fan wheel is of the multivane type, the fan housing is so constructed that the wheel can be easily removed from either side, and an air inlet is provided at each side which may be piped so that air can be drawn into the fan from outside if desired. The fan shaft is provided with a pulley which can be belted to a line shaft, electric motor or engine. Distributing elbows are of heavy gage sheets and furnished complete. Other features of the heater are pointed out and a number of actual installations are illustrated.